POPULAR SCIENCE

FOUNDED MONTHLY 1872

JULY

15¢

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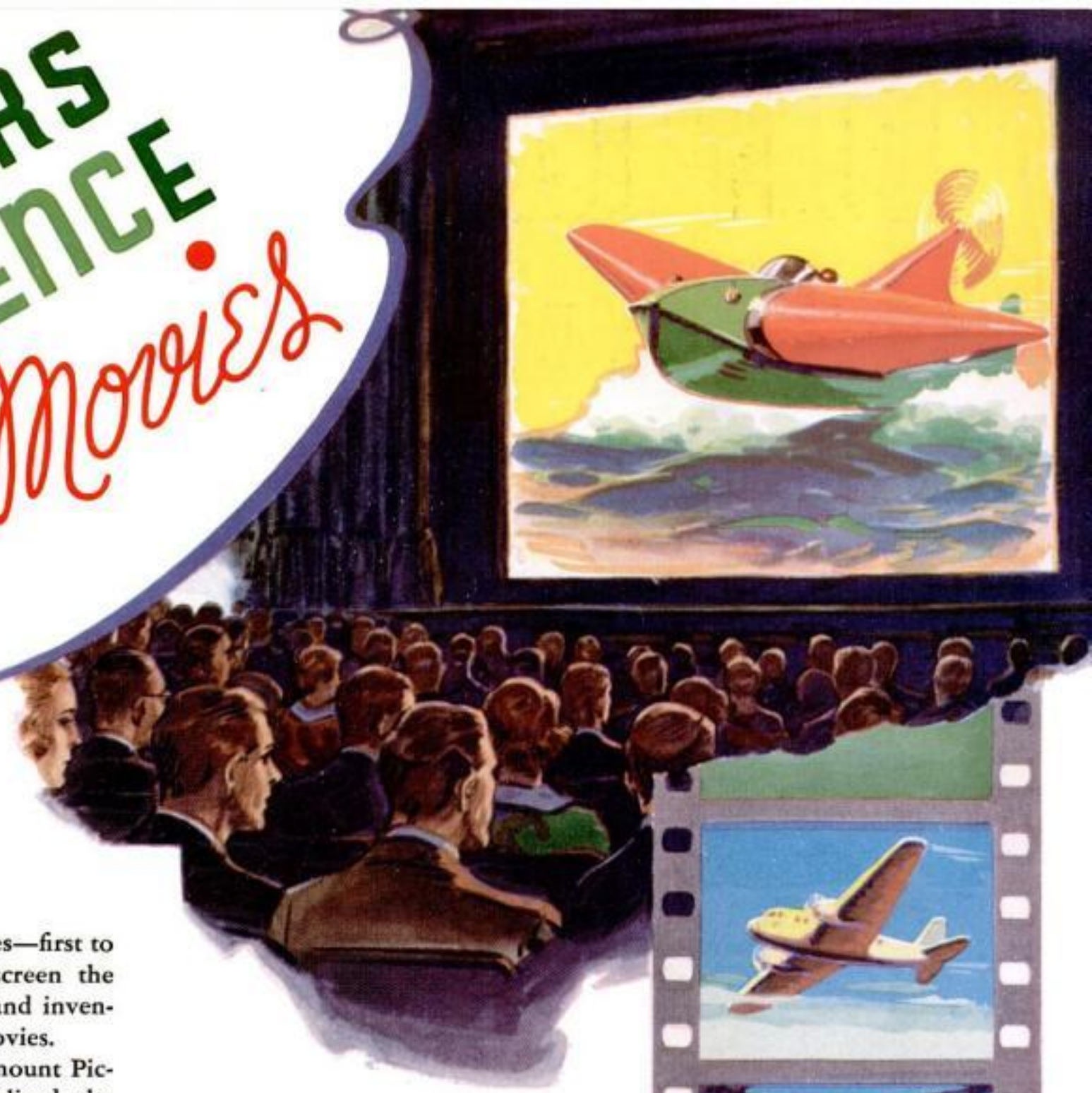
See Page 35

NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS

HOME WORKSHOP PLANS AND HINTS · 350 PICTURES

See the WONDERS OF SCIENCE in Color Movies



NOW Paramount Pictures—first to do it—brings to the screen the current marvels of science and invention, in sound and color movies.

For many years the Paramount Pictures Corporation has realized the public's keen interest in the drama of scientific achievement—in the mysteries of sun, moon, and stars; in the marvels of fish and bird and rock and insect life; in the wonders of the microscope and the test tube; in the amazing developments in lighting, heating, transportation, and communication.

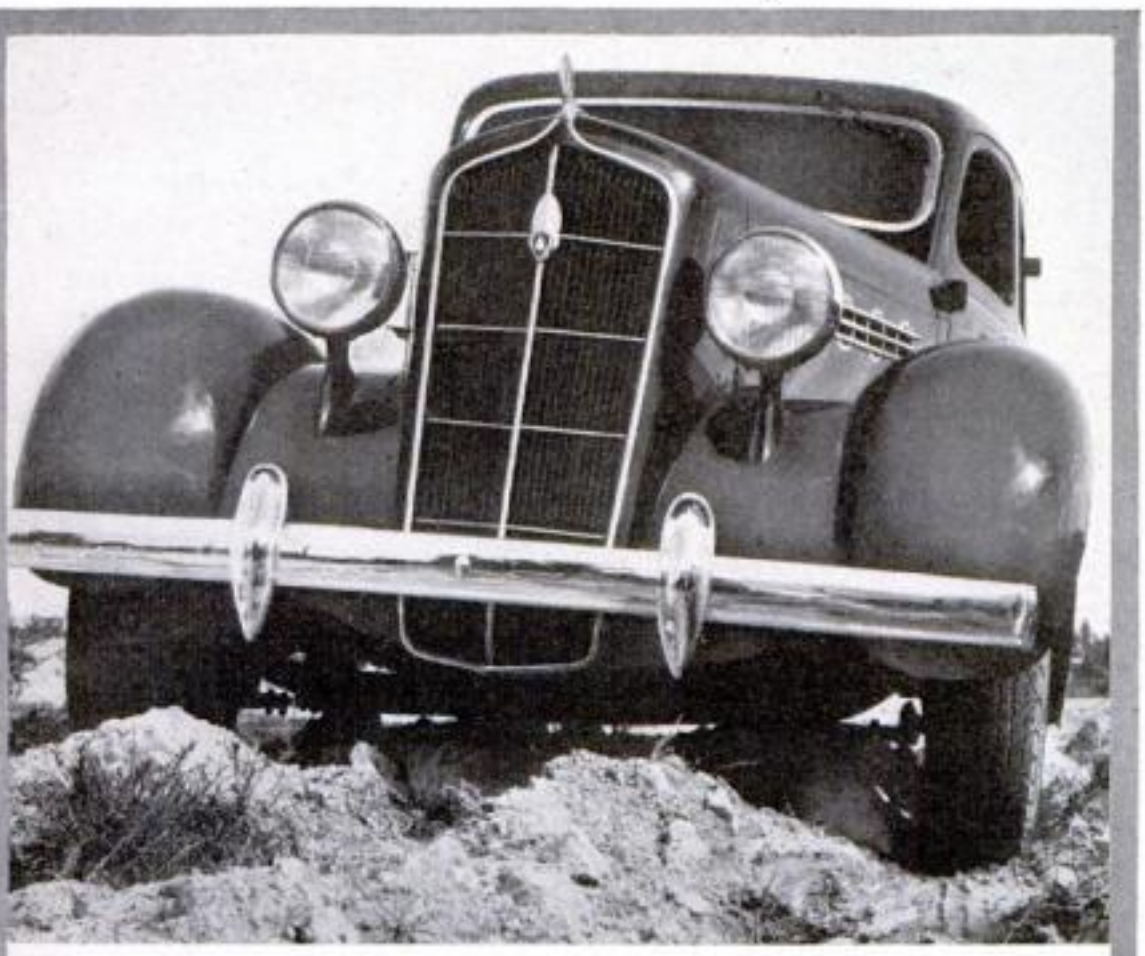
Recognizing the part that Popular Science Monthly plays in making science understandable, the Paramount Company sought and secured the coöperation of this magazine's editors in the making of these films. Through this coöperation the pictures have been made by Jerry Fairbanks, a producer of scientific motion pictures who owns the most elaborate equipment, including microscopic cameras, for making moving pictures of this kind.

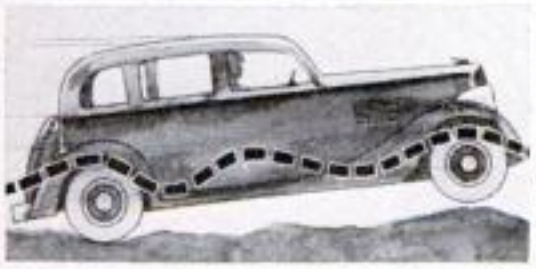
The first of this series of pictures has now been released.

Go to your local theater and ask when the Popular Science Pictures will be shown. Tell your friends to ask for them, too. They are the most thrilling of modern motion pictures.

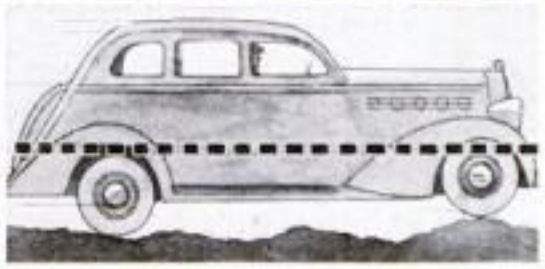
A Paramount Picture

NEW CAR ABOLISHES REAR SEAT "BOUNCING"





BUMP—BUMP—BUMP! This indicates the galloping, "pitching" action of the ordinary car, caused by old-style weight distribution and springs... particularly uncomfortable in rear seat.



FLOATING ALONG! The smooth, Floating Ride of the new Plymouth—with modern weight re-distribution, and softer-acting new-type springs, having same "rate" front and rear.

Engineers remove cause of "pitching" and bumps ... give New Plymouth its famous Floating Ride

FOR YEARS, there wasn't much comfort riding in the rear seat of any car. Even small road bumps would make the car "gallop"... and give back-seat passengers a good shaking-up.

Then, after years of study, engineers discovered a new principle—which was introduced in the famed "Airflow" cars.

Seats and engine were moved forward, equalizing the weight on front and rear springs. Now the same principle is used in one of the lowest-priced cars on the market: the beautiful, new Plymouth.

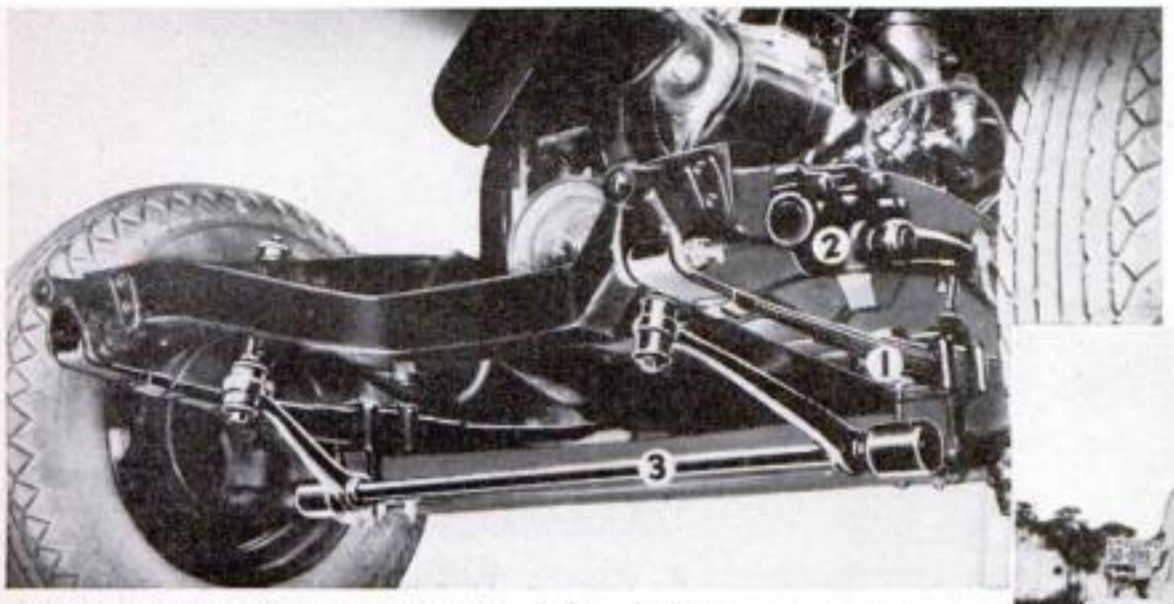
In addition, a new type of spring has been perfected—with tapered leaves, and made of special Mola steel. And a sway-eliminator has been added at the front... to hold the car steady and upright on curves.

Gives famed "Floating Ride"

The result is a miraculously smooth, restful ride. There is no bouncing or pitching. The back-seat rides like the front. You can hardly believe you're riding in a low-priced car!

Be sure to ride in "All Three" leading low-priced cars... and just compare the others with Plymouth's Floating Ride!

Ask your Chrysler, Dodge or De Soto dealer about the new Plymouth... now only $510 and up, list at factory, Detroit. Official Chrysler Motors Commercial Credit Plan offers convenient terms.



PLYMOUTH'S SWAY-ELIMINATOR, (3)—holds you steady on curves, even at high speeds. Note, also, (1)—Plymouth's new tapered leaf springs; and (2)—double-action shock absorbers.

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FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

ENGINEERING

Making Money With Your CAMERA

Here is a bran-NEW, exceptionally practical manual which will teach you many kinks and tricks, ways and means to take and sell pictures. Written entirely for the amateur or semi-professional camera hobbyist, it clearly demonstrates by pictures and directions the principles of picture taking that bring you photos which are marketable—and how and where to sell them.

COMPLETE, FASCINATING
Easy To Understand

The ingenious amateur who can learn how to apply some of the simple rules in this book can make enough money with his camera to pay for all his photographic activities, and lay aside some welcome profit as well.

THE TWENTY FIVE SECTIONS

of the manual cover such subjects as: Photography Isn't Difficult; Salable Pictures of People; Dollars From Architectural Photography; Pictures For Publication; Pictures For Rotogravure Sections; Ventures In News Photography; Syndicating Photographs; Pictures For The Magazines; Landscape Dollars; Selling Photographs To Manufacturers; Developing and Printing For Others; Miniature Camera Possibilities; Lantern Slides and Their Relatives; Salvaging Old Photographs; Still-Life Photography; Photographic Novelties; Accidental Profits; Nature Photography; Movie Profits; Coloring, Retouching, etc.; Invisible Light Magic; What About Stereo Photography?; Useful Accessories You Can Make; Miscellaneous Information.

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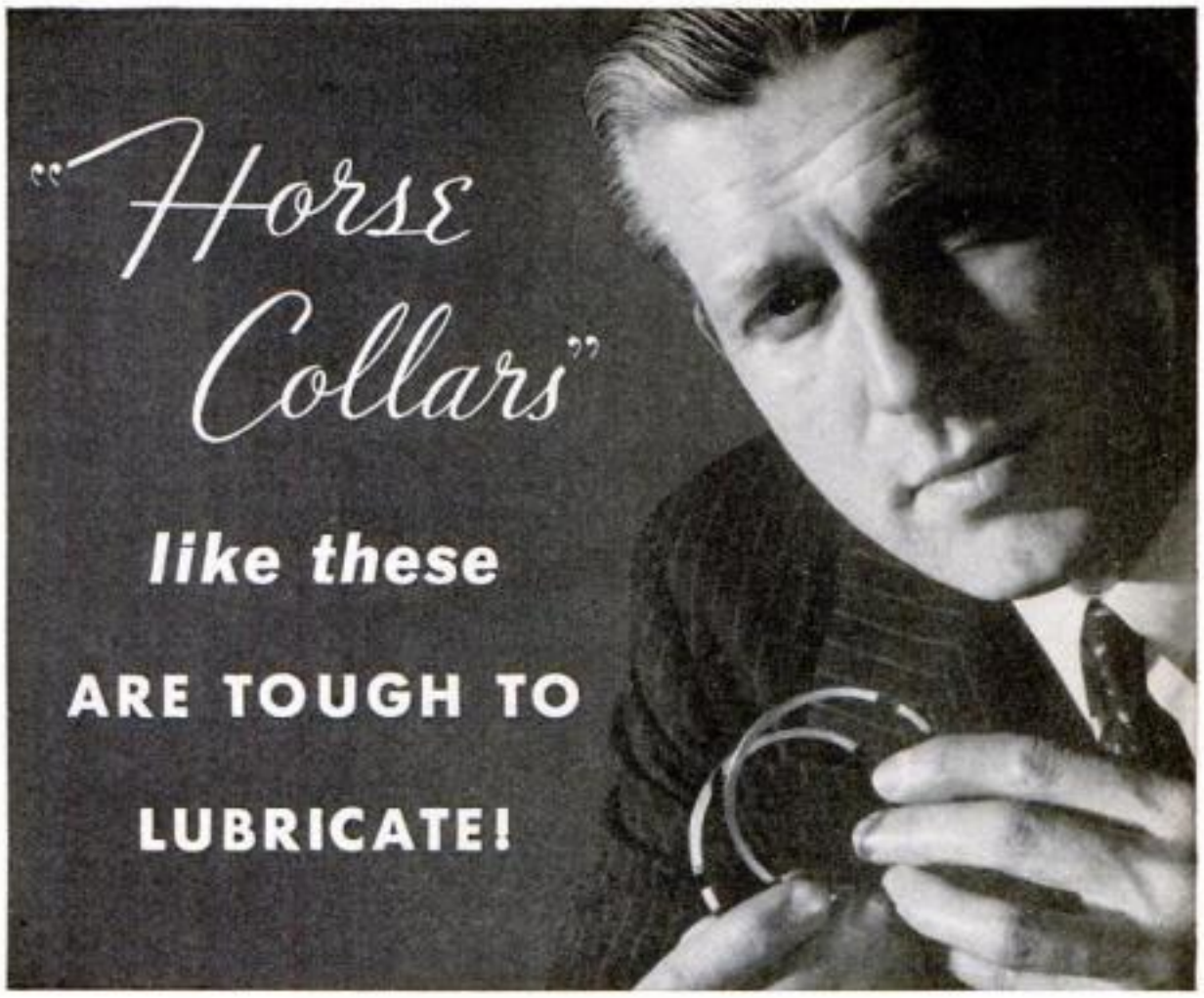

YES, THESE are horse collars — the modern kind—piston rings! They harness the might of 60 to 100 horses.

Piston rings are vital parts of your motor. Pennsylvania motor oils supply special lubricating qualities to keep these vital parts—and others, too—from "gumming up" or wearing away.

"New" oils, made by new processes, frequently claim to be "equal to Pennsylvania." But trying out new unseasoned oils is costly business. As one engineer puts it: "There's simply no use taking chances, as long as I can get Pennsylvania oil." He's right! For smooth, sure protection and unfailing performance, you want oils that have thoroughly proved their worth. And that, for 40 years, is exactly what Pennsylvania motor oils have done.

Look at the map! The area shown there is where Nature stored her richest, finest lubricant — Pennsylvania Grade crude oil. From this one special crude are refined all the motor oils sold under the insignia of the Pennsylvania Grade Crude Oil Association.

No *refining* method can take the place of the best *raw material*—Pennsylvania Grade Crude. Pennsylvania motor oils are *better oils from the ground up.*

For trustworthy lubrication, insist on a Pennsylvania motor oil sold under the emblem shown below!

Pennsylvania Grade Crude Oil Association
Oil City, Pennsylvania

◀ FINE OILS FROM THIS REGION...

ARE IDENTIFIED BY THIS EMBLEM ▼

MEMBER OF PENNSYLVANIA GRADE CRUDE OIL ASSOCIATION
Guaranteed 100% PURE
PENNSYLVANIA OIL
PERMIT NUMBER .....
Made from the highest grade crude oil in the world

BETTER OILS FROM THE GROUND UP!

What This Emblem Means!

This emblem is the badge of membership in the Pennsylvania Grade Crude Oil Association.

You are protected when you buy oils sold under this emblem, because it assures you that (a) they are made 100% from Pennsylvania Grade Crude, (b) they meet or exceed the high minimum standards set by the Association to assure proper lubrication of modern motors.

Safeguarding these assurances are: (1) the research laboratory of the Association at State College, Pa., (2) a national field force, and (3) each member's individual surety bond.

PENNSYLVANIA MOTOR OILS

POPULAR SCIENCE MONTHLY FOR JULY, 1935

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

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OLD-FASHIONED SIMPLICITY

TELEPHONE SERVICE in this country is modern. It leads the world. Yet there is an old-fashioned simplicity about the Bell System. This applies to capital structure and financial methods as well as to the nation-wide plan of decentralized operation under centralized control.

The American Telephone and Telegraph Company has only one class of stock and that stock is not watered.

It has 675,000 stockholders living in every corner of the land. Their average holding is twenty-eight shares. No individual or organization owns as much as one per cent of the stock. There are no secret reserves or hidden assets.

This structure is not of recent origin, but dates back many years to the early days of the telephone. It has lived on because it is right and in the best interest of the public. It has been fundamental in making the Bell System a distinctive American business.

Research for the Bell System is carried on by Bell Laboratories. Manufacturing, purchasing, distributing by Western Electric. Both help in giving the country good, economical telephone service.

BELL TELEPHONE SYSTEM

Old paint can be taken off easily with new paint removers available in paste or liquid form

Home Repairs MADE EASY

With These New Tools and Materials

TWO new types of paint removers can be added to the list of timesavers for the home owner. One, a paste, is designed especially for outdoor work. The other, a liquid, will remove paint from metal as well as wood and is especially valuable for removing the old finish from the body of a car. The paste remover first is made into a solution with water and then applied to the surface with a brush. After a few minutes, the old paint can be peeled off easily and quickly with an ordinary putty knife. The liquid remover also is applied with a brush, but a hose and a sponge replace the scraper to remove the loosened paint. Either warm or cold water literally washes off the old coating, leaving the surface smooth.

BRACE ADAPTER CHUCK TAKES SMALL DRILLS

DESIGNED as an aid to the handy man whose supply of tools is small, an inexpensive adapter chuck recently introduced transforms the usual bit brace into a two-in-one unit. Having close-fitting, spring-operated jaws, it makes it an easy matter to use small, round drills in the ordinary hand brace designed for wood bits. Its three jaws will grip even the smallest drill tightly, while its square tapered shank fits into the chuck of a hand brace like an ordinary bit. Putting it in place or removing it is just a matter of a few seconds. A few twists of the wrist double the usefulness of the brace.

NEW WATERPROOF PUTTY IS MADE OF RUBBER

BECAUSE it never hardens, is waterproof, and sticks to metal as well as wood, a rubber putty now on the market provides a good material for use in sealing glass in picture frames and any type of window. Containing rubber, the new putty also is flexible and will not shrink or crack. It can be applied with an ordinary putty knife and takes paint readily without causing it to crawl or blister. Sold in friction-top cans, it can be stored easily without fear of spoiling.

EXTENSION HINGES MAKE WINDOW WASHING EASY

BOTH sides of a casement window can be washed easily from the inside if it is fitted with a pair of the extension hinges shown. Projecting from the sill several inches, they swing the window free of the frame and provide enough space on the hinge side to allow the arm to pass through. Easily applied, they require only a few screws and can be put in place on any casement window in a few minutes.

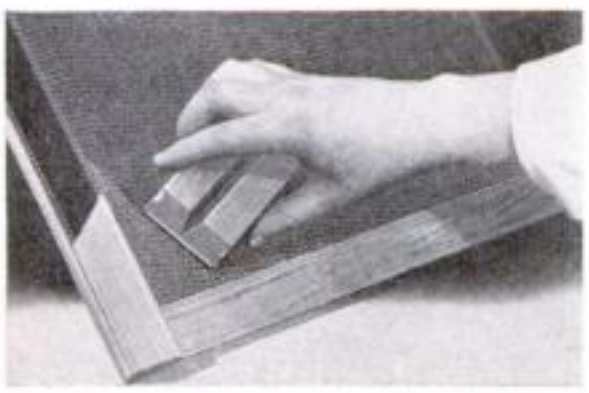
With these extension hinges, the task of washing casement windows is made much less difficult

NEW FIREPROOF PLASTIC

AMONG the materials available for summer furnace repairs is a new fireproof plastic. Capable of withstanding a temperature of 3,000 degrees F., the easily molded substance can be used either as a crack filler or as a fire-pot lining.

HANDY APPLICATOR FOR REFINISHING SCREENS

RESEMBLING a blackboard eraser, a new type of applicator simplifies the job of refinishing window screens. Dipped in the enamel and rubbed over the wire screening, it spreads the finish evenly and quickly, insuring a smooth surface and eliminating the thick spots, filled-in places, and spatters usually associated with amateur screen-refinishing jobs. It is designed for use with a new special screen finish that dries quickly, prevents rust, and is self-smoothing.



Screens refinished with this handy enamel applicator have the smooth finish of professional work

Our Readers Say

Just What Laws of Physics Do You Mean?

To us young fellows out here, surfboarding is, in the large part, the biggest form of amusement. I see, too, that it has been taken up at many California and Florida beach resorts. The history of surfboard riding is interesting, all right, but what is more so is the way in which the Hawaiians seem to defy all the laws of physics by riding huge waves, twenty feet high, that nearly give a *malahine* heart failure. Surely, one of you myriads of readers can tell us the secret of high-speed surfboarding.—O.Y., Honolulu, T. H.

A Business That Is Always Active

For the world's champion partnership I nominate the firm of Plankton and Benthos. They are in business twenty-four hours in the day; in fact they never stop working. Without them, the land might soon be overrun with creatures from the sea, and human life could not exist. For plankton is the weak swimming life in the sea, and benthos, the life upon the sea's floor. One partner feeds upon the other, and together they maintain the balance of life. Something to wonder at!—C.F. P., Detroit, Mich.

Aquarium Beautifies Fireless Fireplace

I believe I have a new idea for you. Here it is. We have an open fireplace in our living room. We grew tired of our gas logs, and removed them. In their place we put two layers of brick to match the mantel, just large enough to fill the opening. On top of them we put an oblong glass aquarium, twenty by twelve by sixteen inches, with fish and green plants and shells. Behind the brick platform we laid an electric cord and a red light, which, when turned on at night, gives the aquarium a sunset glow. Our living room has taken on a delightful aspect, and we get many compliments for our original idea, which we now gladly pass on to all interested readers of Popular Science Monthly.—R.P.H., Lockland, Ohio.

Wigwams, At Least, Are American

What America needs is some American architecture. Nearly every house in the United States is either Greek, Roman, or Gothic in design. Why not a house that is an expression of American ideals? I mean the ideals of courage, progress, honesty, frankness, and *inventiveness* typical of the frontiersman and pioneer. Come on, some of you, submit some suggestions for a real United States architecture. It's high time somebody did!—McK.,M., Cambridge, Mass.

Freakish Tricks Played By a Volcano

Reading the article on the "Earthquake Machine" in the May issue of Popular Science Monthly, I was reminded of a strange story I heard recently. It concerns a volcanic eruption, rather than an earthquake, but, after all, the two are related. A geologist friend of mine, who has been prospecting for rare minerals on the volcanic islands of the Caribbean, told of seeing relics recovered from the ruins of Saint-Pierre in Martinique. This city, as everybody knows, was destroyed by an eruption of Mont Pelée in 1902. It seems that the disaster took the form of a sheet of flame which came down the side of the mountain and seared everything in the town. In the ruins of the stores, excavators have found bottles of perfume with their necks sealed by the heat; when the bottles were broken, the scent was found unimpaired after more than thirty years under the ashes. In the banks, stacks of gold coins were found fused together in rods of solid gold.—J.B.B., New Orleans, La.

This Windmill Thought It Was an Autogiro

Some time ago while working on an experimental wind electric plant, I built a new type of windmill. It was mounted on a turntable on top of a fifty-foot barn, and instead of using blades for the propeller, I used two old auto wheels, which I fastened one at each end of a five-foot shaft. This shaft turned in a block with adjustable bearings, fastened to the turntable. Running full length, between the wheels, I fastened sheets of tin, to form pockets, six of them. After I got this assembled, I connected the generator as a motor, and turned on the juice to see how it would run. Just as I got outside the barn to take a look, the whole contraption started up into the air, pulling turntable and generator right up the turntable shaft with it. Of course, at about two feet, things flew all apart. I got the idea that a contraption built up in sections so one section would revolve right and the next left would produce an awful pulling power. These sections could be built about the size of a common steel barrel, and driven at a high rate of speed. They would certainly haul something up into the air, and would save weight and space.—C.W.P., Fort Wayne, Ind.

And No Fair Using Junior's Blocks

Here's a problem to be done without using any pencil or paper. It is a test in what is known as power of visualization, and it is a tickler. After you have tried to figure it mentally—and lots of people get it right by sharp thinking—you can figure it out on paper, if you must. Here goes: a cube is built of small cubes, uniform in size. Each small cube is a cubic inch. The large cube is three inches wide, three inches high, and three inches long; in other words, each face of the big cube is nine square inches in area. Now then, a coat of paint is applied to the exterior of the large cube. How many of the small cubes will be painted on three sides, how many on two sides, how many on one side, and how many on no side at all? Can you do it?—E.H., Des Moines, Iowa.

Maybe That's What They Call Truck Farming

I've seen a couple of letters on the Fred Frame vs. truck drivers argument. I don't care how Fred drives a car in races, but I want to say that truck drivers are good drivers! They have to be. Out here where I live, we are ninety-two miles from a railroad. All goods are trucked in; farm products are trucked out, excepting some of the livestock that goes out under its own power. It's all dirt roads, and up until two years ago sixty miles of it weren't even graded. It isn't sandy soil, either; it is real, old-fashioned gumbo, if you know what that is. I've had balls of mud as big as wash tubs form on the wheels; I've even had to take the wheels off to clean them. I still say, a truck driver *has* to be good.—W.S.S., Broadus, Mont.

It Must Have Been An Emergency Light

One night a friend and I were running my electric train in the basement when it was derailed. The wreck smashed the burned-out light bulb in the headlight of the engine. We put the cars back on the track and turned on the current again. To our great surprise, Mr. Busted Bulb, which had not been removed, lit up and stayed lit for about three seconds. Perhaps some of your intelligent readers can tell us "how come."—R.J.R., Sioux Falls, S. Dak.

You Have To Jump First, And Then Listen

Like everybody else, I generally jump or give a start at any unexpected loud noise, such as an automobile backfire. Now, I've noticed a curious thing—that I jump *first* and hear the sound *afterward*, with just a split second in between. This is just the opposite of what might be expected, it seems to me. The natural sequence of events would be for the nerves of the ear to carry the sound to the brain, where it would be heard, and for other nerves to carry an impulse from the

brain to the muscles. Perhaps jumping at a loud noise is a reflex, however, in which this roundabout mental process is short-circuited; if so, what touches off the reflex? The powerful air waves striking the skin? Here is something a scientist might find interesting to investigate. I wonder how many readers have had a similar experience, and whether any of them can suggest an explanation.—E.F.C., New York, N. Y.

This Idea Is as Old as The Ben Hur Sweepstakes

THIS suggestion may seem goofy, but it has its points. At a horse race, you miss about half the excitement because the horses are so far away when they are on the backstretch. Why not have a rotating track so the horses would be running in front of the stand all the time? Or have the stand revolve around the track to keep up with the horses just as an observation train follows along the shore during a crew race? Why should the spectators only be in on the start and the finish?—H.H., Baltimore, Md.

Gold-Mining Methods for Finding That Ring

IT SHOULD be easy for G.C.K., of Whippany, N. J., to find his gold ring, if he really knows just about where he lost it. He should first burn and cut off all grass and weeds where the ring could have fallen or rolled. Then take a screen just coarse enough that the ring can't go through it, and mount it horizontally in such a way that it can be shaken. Shave a layer off the ground, going as deep as any scratching or digging that has been done since the ring was lost. All this dirt should be put through the screen very carefully and the oversize sorted. If he does the work thoroughly and systematically, he can't help finding the ring if it is there. The job should not take long, unless the area is very large. I have followed gold mining all my life; we wash our dirt to get the gold from it, but G.C.K. can solve his problem by merely screening the dirt. Here's hoping he finds his ring without having to shovel up the whole county.—H.W.H., Rocklin, Calif.

Self-Making Bed Is Boon to Bachelors

SOME time ago a reader mentioned a "self-making bed" as an invention that ought to be worked out. This old bachelor agrees. How would this do? Take a bed with no railing at the foot, like a studio couch, and fit a U-shaped frame of light lumber around it. Pivot the frame near the head of the bed, on each side. Have clips along the squared bottom of the "U", and eyelets at one of the narrow ends of all the bedclothes. Now clip on sheets and blankets as desired. Up with the frame, and all the bedclothes hang vertically, arranging themselves and smoothing themselves out. Down with the frame and the bed is made, the overlapping parts of the bed covers being caught and held by the frame. Remaking the bed means simply raising the frame and letting it down again. Of course there should be enough clearance so as not to tear the bedclothes. Maybe there's a catch in this somewhere, but I don't see it.—K.R., Long Island City, N. Y.

Stratosphere Flights Went Over This Reader's Head

ANOTHER giant balloon will invade the stratosphere this summer starting from the natural bowl in the Black Hills. In the metal-ball gondola, daring men will risk their lives for science. Why? What good can result? A few weeks ago, I would have been pretty positive about answering, "none at all." But I'm less cocksure now about a good many things. And it's all due to an article that appeared in your April issue. For years, I have believed that auto racing was nothing more than high-speed murder and suicide, without a redeeming feature. Your article opened my eyes. I had no idea that most of the improvements that make modern cars safer and better could be traced directly to the race tracks. Hereafter I am going to be more careful about condemning daring undertakings as of little value. —R.E., Nashville, Tenn.

But the One That Got Away Was Much Larger!

FIELD naturalists of the hothouse variety seem to think that six-inch trout are about the biggest fish that swim in the rivers of the United States. Well, let me tell you that the biggest, proudest, strongest denizen of the rivers of this country is being overlooked. I suppose it's because he's too big to be believed in. He's the Columbia River sturgeon, that sometimes weighs almost a ton.—R.E. R., Seattle, Wash.

Maybe he was Trying to Imitate a Blowfish

I WOULD like to give some information to goldfish keepers whose fish are having trouble staying at the bottom of the aquarium. I had a fish that continually got indigestion and accumulated gas within himself, that brought him to the surface. I found that a tinge of mercurochrome in some water acted as a slight laxative and cured him within a couple of hours. This is also good for fish as a stimulant.—J.D.L., Riverton, N. J.

Has any reader some ideas on how to make a mechanical aërator for a tropical fish tank? I would very much appreciate a few suggestions.—F.M., Brooklyn, N. Y.

They Might Put the Rug In a Zoo

I SEE that a rug made out of the skins of eighty duckbills has been placed on exhibition in New York. The duckbill, or platypus, is one of the strangest, rarest, and most delicate of zoölogical specimens. It is not adapted to travel or to captivity in a zoo. Why anyone should want to make a rug out of duckbill skins is more than I can understand. A good live specimen is worth about $1,400 to any zoo. Why? Because the platypus is an egg-laying mammal, and a possible link, in evolution, between the mammals and the birds. But a rug? I can't see it.—R.N.R., Sydney, N. S. W., Australia.

Keeps Both Eyes Open Now

I USED to think that making myself squint-eyed, wall-eyed, cross-eyed, or bat-eyed by staring through a metal and glass tube at tiny things that you can't eat, drink, talk to, sit down on, or make use of in any way, was the silliest possible way to spend leisure time. Now I know I was wrong. I don't own a binocular microscope, but I am used to keeping both eyes open now, and find my hobby of microscopy not only pleasant but downright exciting.—P.H., St. Paul, Minn.

Reverse Umbrellas To Catch Rain on the Rebound

HERE'S an idea for some of your inventive readers. We have umbrellas, raincoats and sou'westers to protect us from water falling from above. But we haven't anything to protect us from water splashing up from below. What I would like to see is some kind of midget umbrellas or flat oval guards that could be snapped on around the ankles to keep water from splashing up as you walk along on a rainy day. Let's get to work on this.—E.E., Chicago, Ill.

What Do You Predict for 1960 and Beyond?

IT IS July, 1950. The theater is operating under a Government subsidy. Technicians, electricians, stagehands, musicians, all get paid regularly by check from Washington, regardless of the size of the audience. There is no audience, in the old sense of the word. Everybody sits at home with his friends in the little room now known as the Radiotele-theatron. Instead of a television screen, this new machine presents a crescent-shaped stage on which figures, made of light, and appearing to have three dimensions, perform in full color, with sound.—L.P., Los Angeles, Calif.

The Rhinoceros As A Cause of Long Life

AN ELDERLY Chinese gentleman of my acquaintance was asked recently how he managed to grow to be so old "so youthfully." His answer brought to light a strange fact about Chinese medicine. I am turning the fact over to the readers of POPULAR SCIENCE MONTHLY for their entertainment. "I am so old, and at the same time, so youthful," said the aged Chinese gentleman, "because of this drug." He pulled a little lacquer box from his sleeve and showed us a grey powder. "This is powdered rhinoceros horn, of which I take but the tiniest pinch a day," he said, smiling. I visited a Chinese pharmacy subsequently, and was very obligingly shown a quantity of the stuff, which I learned, much to my surprise, costs $100 for about one cubic inch. It was known in Europe, centuries ago, as a cure for fever.—J.E.E., Shanghai, China.

Chemists, Attention! What Turns Glass Purple?

HERE in Arizona, and also in some parts of Texas and New Mexico, and in the dry, hot, desert parts of California, certain kinds of clear glass and some old milk glass turn a perfect shade of amethyst if exposed long enough to the rays of the sun. I have several bottles colored a beautiful purple. Some of you readers can no doubt explain the chemical reaction that occurs. I find that by putting a piece of the deepest color into a fire, it will turn back to its original transparence. Why is that? Also, can you say whether the amethyst color will last if the glass or glassware is kept out of the sun?—Mrs.A.S., San Simon, Ariz.

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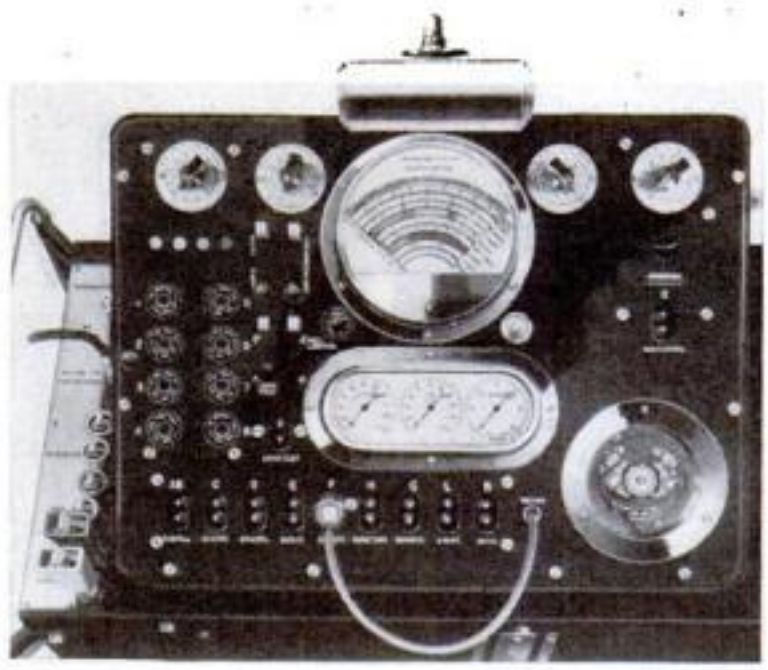
Laboratory Test Set

HELPS AUTO MECHANICS



These instruments and gages tell the complete story.

SCIENTIFIC service-station equipment is eliminating trial and error methods in the work of automobile mechanics. One of the most interesting developments in this field is the Ford Laboratory Test Set. For many months it has demonstrated its uncanny accuracy in the shops of Ford dealers and has proved conclusively that it saves time and money for Ford car and truck owners.

Combining a number of sensitive laboratory instruments and gages in one complete unit, this portable Ford Laboratory Test Set can be rolled to the side of the car. It permits the operator to make tests quickly and accurately for every condition that can affect engine performance and the entire electrical system. Further, it enables him to adjust such units as the carburetor and distributor with a high degree of precision. Ignition coils and condensers can be definitely checked. It determines the condition of valves, piston rings and spark plugs. It tests the car radio and tubes in addition to the lighting circuit, generator, starter, fuel pump and other units.

If the type of precision units co-ordinated in this apparatus were to be purchased individually the cost would be so high that only the larger service stations could afford to use them. The Ford Motor Company has made it possible to build and sell the Laboratory Test Set at a price which every Ford dealer can afford.

This is in keeping with the Ford idea of enabling dealers to provide the most efficient service for owners of Ford cars and trucks.

Master Meter indicates condition of radio tubes.

GENUINE Ford PARTS

FORD MOTOR COMPANY • DEARBORN • MICHIGAN

POPULAR SCIENCE Monthly

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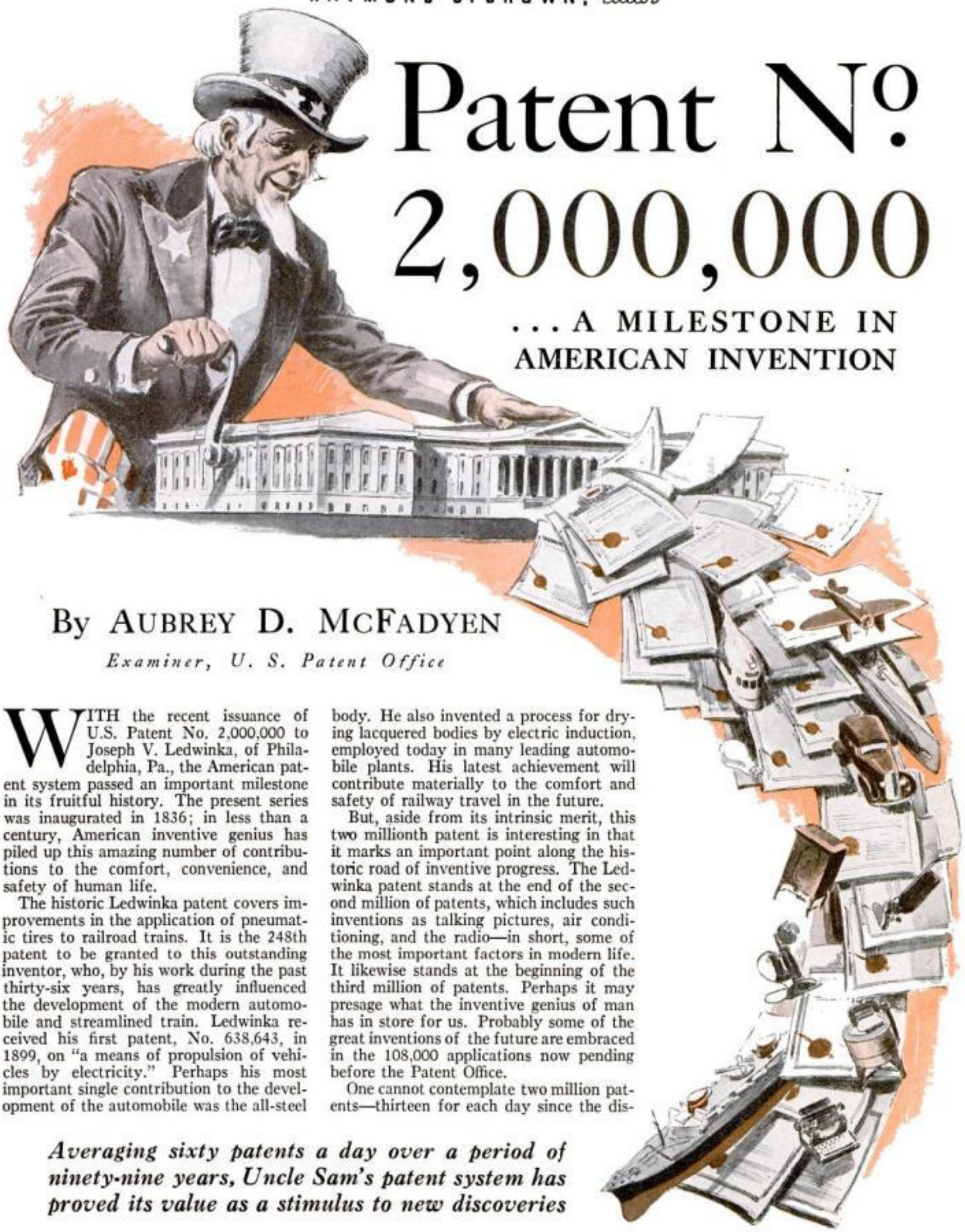
RAYMOND J. BROWN, *Editor*



Patent No. 2,000,000

. . . A MILESTONE IN AMERICAN INVENTION

By AUBREY D. MCFADYEN

Examiner, U. S. Patent Office

WITH the recent issuance of U.S. Patent No. 2,000,000 to Joseph V. Ledwinka, of Philadelphia, Pa., the American patent system passed an important milestone in its fruitful history. The present series was inaugurated in 1836; in less than a century, American inventive genius has piled up this amazing number of contributions to the comfort, convenience, and safety of human life.

The historic Ledwinka patent covers improvements in the application of pneumatic tires to railroad trains. It is the 248th patent to be granted to this outstanding inventor, who, by his work during the past thirty-six years, has greatly influenced the development of the modern automobile and streamlined train. Ledwinka received his first patent, No. 638,643, in 1899, on "a means of propulsion of vehicles by electricity." Perhaps his most important single contribution to the development of the automobile was the all-steel body. He also invented a process for drying lacquered bodies by electric induction, employed today in many leading automobile plants. His latest achievement will contribute materially to the comfort and safety of railway travel in the future.

But, aside from its intrinsic merit, this two millionth patent is interesting in that it marks an important point along the historic road of inventive progress. The Ledwinka patent stands at the end of the second million of patents, which includes such inventions as talking pictures, air conditioning, and the radio—in short, some of the most important factors in modern life. It likewise stands at the beginning of the third million of patents. Perhaps it may presage what the inventive genius of man has in store for us. Probably some of the great inventions of the future are embraced in the 108,000 applications now pending before the Patent Office.

One cannot contemplate two million patents—thirteen for each day since the dis-

Averaging sixty patents a day over a period of ninety-nine years, Uncle Sam's patent system has proved its value as a stimulus to new discoveries

The public scientific library of the U. S. Patent Office, a section of which is shown above, contains records of more than three million foreign patents, and copies of scientific publications

In the photostat division, photographic copies can be made of the original documents on file

covery of America and more than double the number granted by any other nation—without reflecting upon the nature and growth of the American patent system. Most likely, the reader wonders why in the world two million patents should have been granted, and who made this astounding number of inventions.

The principles of our patent system are both simple and brief. These principles have not been materially altered in a century. In general, any person who has invented any new and useful art, machine, manufacture or composition of matter, or any improvement thereof, may obtain a patent on it. An application must be filed with the Commissioner of Patents, accompanied by the necessary papers fully disclosing the invention and the usual fee to cover the cost of examination. The Patent Office thereupon searches through all the prior patents and publications, both domestic and foreign, bearing on the invention, to determine if the application presents something patentable; it must be new, useful, and involve invention. The word "invention" requires that the application present something not obvious and not within the skill of the ordinary mechanic. If the Patent Office investigation is favorable, the applicant is granted a patent covering his contribution.

THE patent gives the inventor the exclusive right for seventeen years to make, use, and sell the invention. The patent carries a legal presumption of validity. In marked contrast with most foreign countries, the United States patent is not taxable nor does it involve any obligation upon the inventor to employ the invention. The patentee can do with his invention as he pleases for seventeen years, at the end of which period it inures to the public.

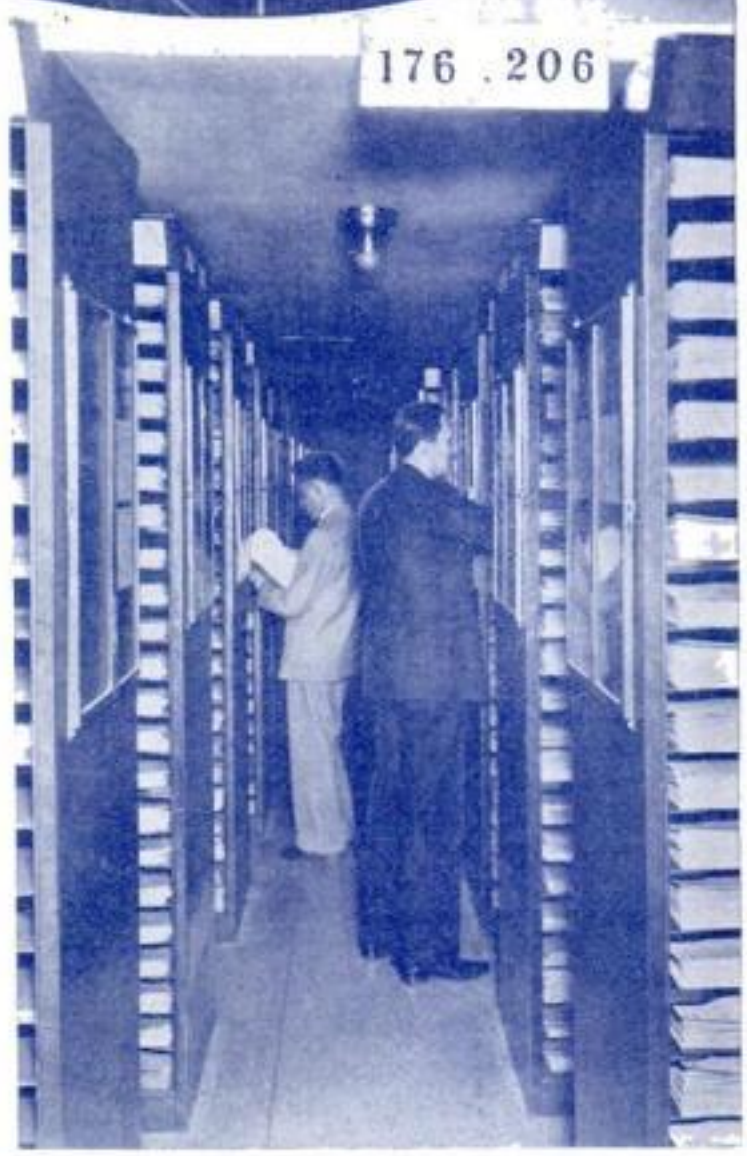
It is interesting to observe how the United States has progressed under this distinctly American patent system. At the time it was adopted we had no telegraph, no rapid printing press, no high-speed steam engine; no harvester, binder, and reaper; no sewing machine, no talking machine; no dynamos, electric motors, or electric cars; no telephones, no electric lights, no electric refrigerators, no electric washing machines, no oil burners, no automobiles, and, of course, no flying machines and radios. One after another, these inventions have been fostered by our American patent system so that new industries have been created, and new avenues of employment provided.

Take, for example, the Bell telephone. From that one invention has sprung one of the biggest industries in the world, providing wages for hundreds of thousands of persons, in every city, town, and village of the country. The moving picture has developed into a major industry, besides furnishing entertainment to the nation. The automobile, aside from its practical benefits, in manufacture, service, repair, and road construction, furnishes employment to far more men than comprised our World War army.

The Westinghouse air brake presents a different aspect. While the president of the Pennsylvania Railroad is said to have laughed when it was suggested that a train of cars could be stopped with air, he lived to see the day when safety laws forbade operating a passenger train not equipped with such air brakes. Westinghouse made the proud boast that this invention, his first, saved more lives than all of Napoleon's armies had destroyed.

The linotype machine, the cash register, the talking machine, the radio, the airplane, and such early inventions as the sewing machine, agricultural machinery, and shoe machinery have each provided this country with an industry employing thousands of workers, to say nothing of the resultant convenience and cheapening of necessities. Inventions in the printing art, for example, have put the daily paper in every home for a pittance. No other country in the world has shown such progress.

In considering the large number of epoch-making inventions that have been made



A section of the file room, where printed copies of all patents are available for sale to the public at ten cents each. The yearly demand for such copies amounts to 7,000,000

by Americans, we must not lose sight of the fact that many of these were the work of naturalized citizens of foreign birth. Alexander Graham Bell, creator of the telephone, and Nicola Tesla, who gave us the alternating-current motor, belong to this class. The atmosphere of encouragement created by our patent system, as well as the rapid expansion of American industry, stimulated such men to inventions which have made them famous throughout the world.

John Ericsson, from Sweden, designed the "Monitor," giving to the world the revolving turret now used in every battleship. Emile Berliner, who came to this country from Germany, invented, among other things, the carbon microphone which is a vital part of the telephone. Charles J. Vandepoele, a native of the Netherlands, devised the under-running trolley and other inventions; Michael I. Pupin, a poor immigrant, invented the loading coil which first made telephoning across the continent possible; Charles P. Steinmetz, known all over the world as the electrical wizard, came to this country in the steerage, so poor that he had to borrow money from a fellow passenger to satisfy immigration requirements.

THE facilities and personnel of the Patent Office have grown with the progress of invention. On January 31, 1791, the first patent granted by the United States Government was delivered to Francis Bailey, a Philadelphia printer, for "a method not before known for forming punches by which to impress on matrices or printing type various impressions difficult to counterfeit." This historic document was signed by George Washington and countersigned by Thomas Jefferson, then Secretary of State, who was designated by the original patent act to pass upon applications for patents. Little did these officials dream of the marvelous inventions and the amazing number of patents that were to follow.

By the year 1836 our Government had granted 9,957 patents, despite adverse patent laws and unfavorable economic conditions. The lack of facilities for passing upon the merits of patent applications imposed a further handicap upon inventors. In July, 1836, Congress first recognized that the magnitude of the task of examining the novelty of inventions and issuing the patents merited the creation of a separate branch of the Government service for that purpose. At the same time the law regarding the issuance of patents was liberalized. The practice of numbering patents and recording them numerically was also commenced at this time.

Thus, from being a stepchild in the Department of State, the Patent Office broke away in 1836 and became a separate unit, with a force consisting of a Commissioner, one examiner, and two clerks. How it has grown! The personnel of the Patent Office today consists of a commissioner, three assistant commissioners, an examining corps of 633 persons and a clerical force of about 600. There are also at least 200 employees in the Government Printing Office engaged in printing and reprinting the patents. The examining corps is now divided into sixty-five divisions, each specializing upon some particular art or field. In the last ten years this force has handled 761,000 applications, resulting in the issuance of approximately 900 patents each week. The assignment division records approximately 50,000 patent deeds each year.

All this belies the oft-repeated opinion that inventors have already devised about everything possible. It is said that in the early seventies an examiner in the Patent Office resigned his position and entered other employment because he was of the opinion that about every invention conceivable by the human mind had been made and he wanted to get into an occupation which offered permanent employment. At that time the phonograph and moving picture, to say nothing of the automobile and radio, and many other inventions, were unknown. The examiners in the Patent Office today have no fear that they will run out of work, for applications for patents are being made at the rate of 60,000 yearly.

The patent examiners, a few of whom are shown above, must pass upon every application. In the last ten years, this force has handled a total of 761,000 applications

Conway P. Coe, Commissioner of Patents, issuing U. S. Patent No. 2,000,000 to Joseph V. Ledwinka (at the left) in Washington, D. C.

THE Patent Office occupies the north wing of the new Department of Commerce Building. It is by far the best-equipped office of its kind in the world.

The dominating feature of the Patent Office is its scientific library and search room. The library contains copies of patents of all foreign countries—about 3,250,000 patents in all—besides copies of all publications pertinent to science and invention. The search room is the only place in the United States where copies of all our patents may be found segregated into groups according to subject matter, or "classes," such as apparel, beds, glass, and music. Both the library and search room are available to the public. Duplicate copies of all records are provided in the examining divisions for the private use of the examining corps.

Now, suppose you desired to see what had been patented in beds, for example. It would take two or three weeks to review carefully all the patents relating to beds; so to make it unnecessary to look through all these patents, they have been subdivided into 364 groups, such as berths, sofas, cots, and hammocks. One can find, therefore, the particular type of bed he has in mind without reviewing the entire field. The art of music likewise is divided into 521 subclasses.

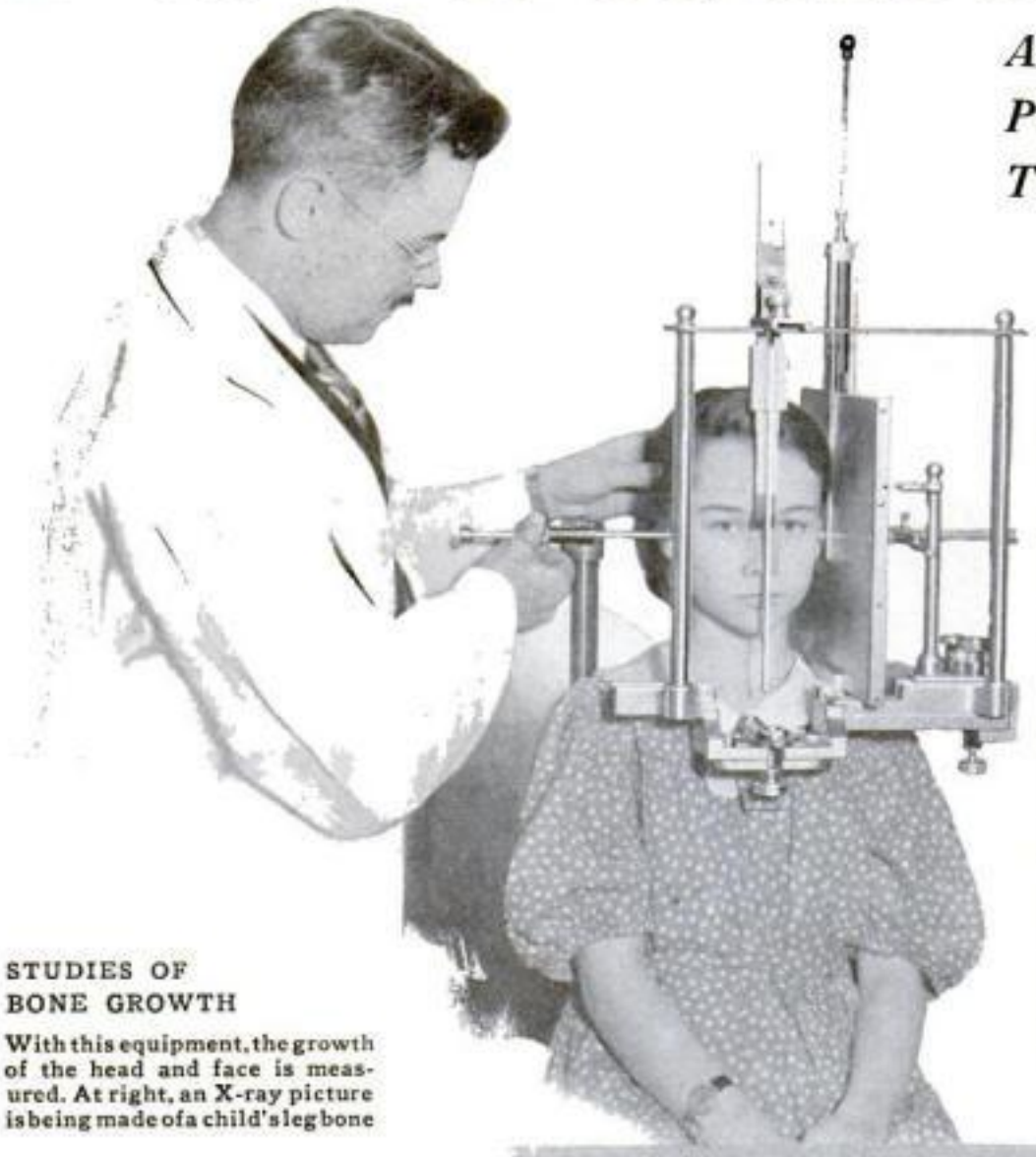
As one browses through these groups of patents it becomes evident that every invention we see in daily use is the result of a process of evolution. Any invention you could name represents the summation of improvements thought out by many inventors. Each succeeding patent represents an addition to preceding developments. Edison probably had this in mind when he once stated that his work was largely in perfecting the ideas of other inventors. Frequently, in this process of evolution, the final form an invention assumes is so far removed from its original arrangement that it is difficult to associate the two.

In tracing the development of a device through the patents from germ to finished structure, the ancestors of modern apparatus often present curious, although logical, steps. One of the earlier progenitors of the typewriter actually wrote the words out in script instead of printing the letters. Likewise, the transition from Old Dobbin to the motor car included a sort of twilight period during which the shades of Dobbin were yet visible. A Frenchman thought to bridge the gap by *(Continued on page 102)*

New Studies of BONES

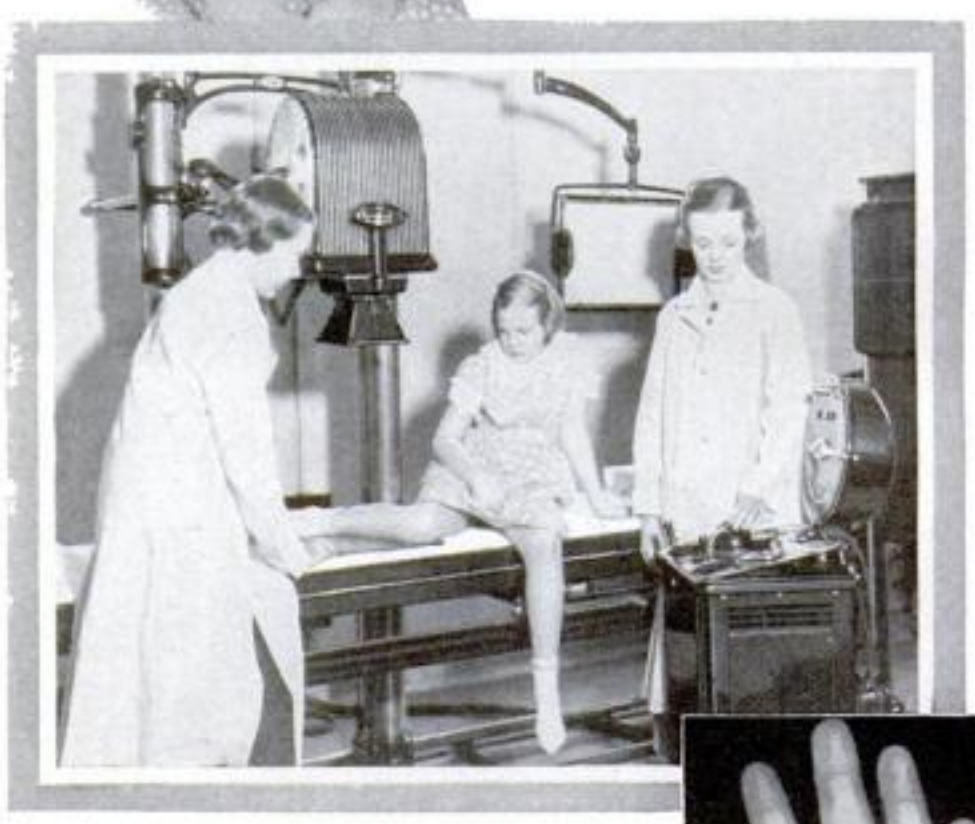
Accurate Measurements and X-Ray Pictures Reveal the Development That Molds Our Minds and Bodies

By JOHN E. LODGE



STUDIES OF BONE GROWTH

With this equipment, the growth of the head and face is measured. At right, an X-ray picture is being made of a child's leg bone



WRITTEN on the bones of your body, Ohio scientists have discovered, is an amazing record of your past.

Thousands of experiments at the Brush Foundation, Cleveland, Ohio, have enabled research workers to decipher marks left by Nature upon the human skeleton. Slight scars in the tissue and the size, shape, and condition of the bones reveal surprising things. With X rays, precision calipers, and original apparatus, the scientists read the story of improper diet, illness, operations, and even serious emotional upsets in a person's past.

In the course of their studies, they have uncovered curious and important bits of information. They have discovered why some people remain baby-faced after adolescence. They have found that wrong diet may produce a pug nose. And, they have learned to read from our bones what we ate when we were six or ten or twelve years old.

About six years ago, the research work began at Cleveland when Charles Francis Brush, inventor of the arc light, donated $500,000 to establish the Brush Foundation at Western Reserve University. Its aim is to carry on studies leading to the betterment of the human race. The chairman of the foundation is Dr. T. Wingate Todd, anatomist and anthropologist, who since the beginning has been in charge of the bone-research studies.

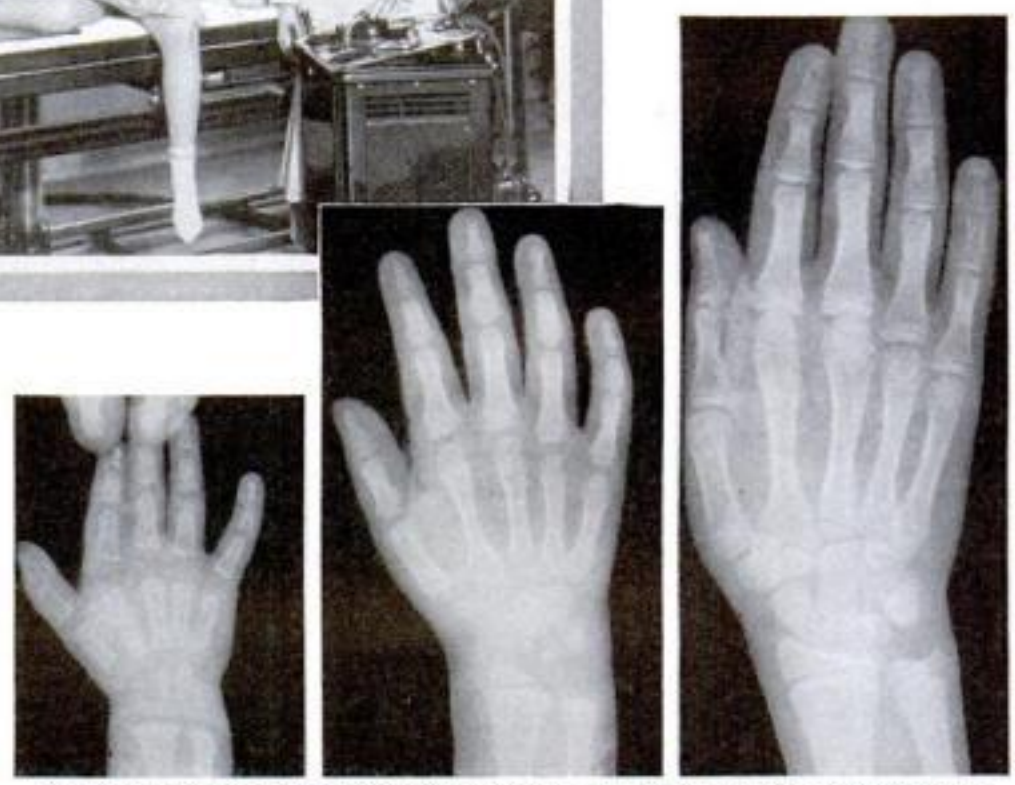
For him, the work is a hobby as well as a vocation. He has spent most of his life in the study of skulls and bones and one of the things he takes most pride in is the curious anthropoid catacombs occupying a whole corner of the Western Reserve medical building.

Here, you find row on row of neatly arranged ape skulls. In addition, there is a vast array of miscellaneous bones and a supplementary section housing 2,500 human skeletons, filed away in labeled boxes. In the present researches, this huge reference collection has proved of inestimable value.

Four thousand Cleveland children also have aided in the experiments. They have been measured and X-rayed over and over again, the X-ray phase of the work often beginning before birth. The result is a mass of data and photographs which reveal, like a vast scientific movie strip how the human body unfolds.

One of the most interesting phases of the work has been the discoveries made in connection with the human face. For instance, the experiments have revealed that during the first five years, a child's face grows most rapidly in a horizontal, or broadening, direction; after that, in a vertical, or lengthening, direction.

Facial bones, the experiments show, are extraordinarily sensitive to disturbances in growth. If anything interferes with normal bone development in childhood, the appearance of the face is altered for life. Records at the Cleveland laboratory show that faces of undernourished children develop at a rate below normal. A change of diet will restore the normal growth, but the damage is done. In many cases, such



X-RAY PHOTOGRAPHS SHOW HOW A BOY'S HAND DEVELOPS
Note the gradual filling in of the wrist bones in this series of pictures of the hands of boys aged six months, four years, and thirteen years, respectively

Show How We Grow ·

halted facial development accounts for grown-ups who are baby-faced.

Again, pug noses sometimes can be traced to improper diet in childhood. Successive X-ray negatives at the Foundation give a clear picture of the way a nose grows on a human face. During the first six months of a baby's life, the nose grows most rapidly in the upper third, or smelling region. Then, the middle part forges ahead during early childhood. And, finally, the lower part unfolds to its proper extent during the period reaching to adolescence. If anything arrests normal development before adolescence, the result may be a pug or snub nose.

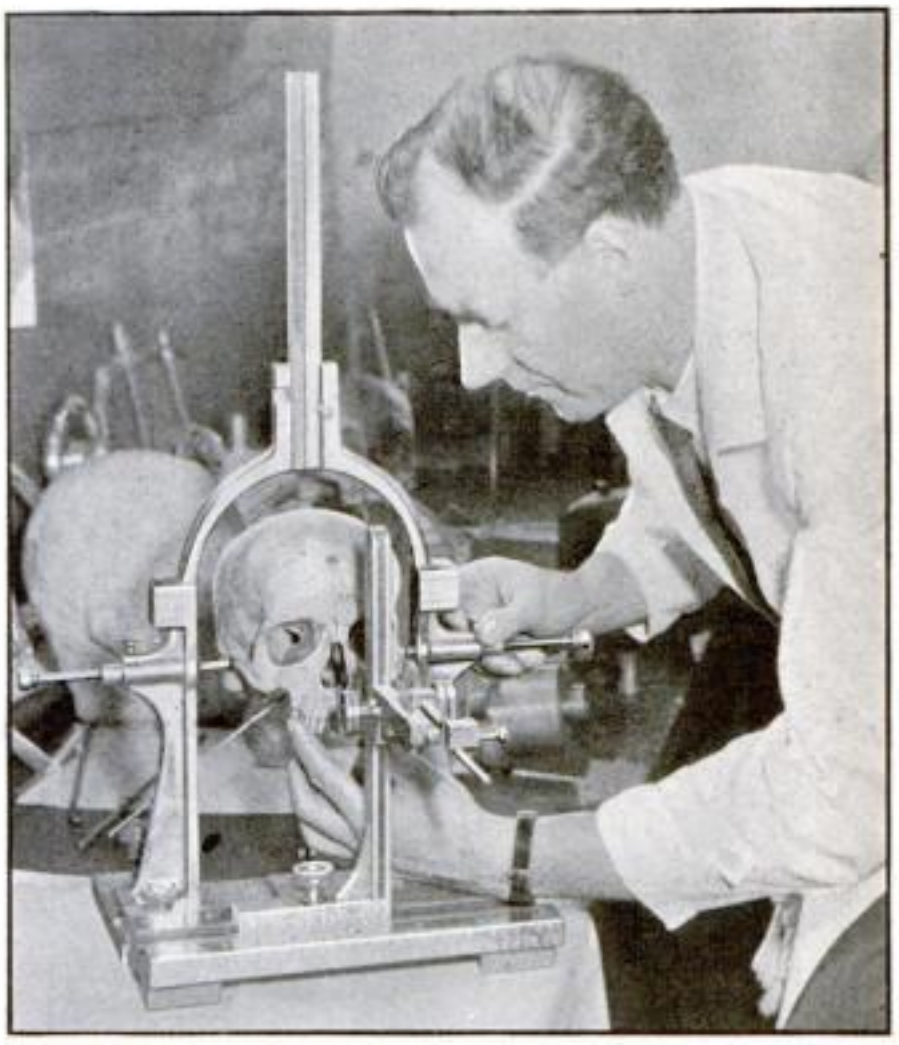
ANOTHER interesting fact discovered during the studies is this: It takes longer to make a boy's face than a girl's. The upper part of the head, above the nose, grows with about the same rapidity in both boys and girls. But, when adolescence is reached, the face of a girl stops growing while that of a boy continues for several years, the lower lip lengthening and the jaw becoming more masculine.

In making these head studies, Dr. Todd and his associates use a curious apparatus with sliding rulers, rubber-tipped arms, and a battery of thumbscrews. This complicated framework of polished metal holds the subject's head always in the same position when the X-ray pictures are taken. Two tubes, one at the back and one at the side, give off the rays that record a rear and a profile view of the skull bones.

Another, even stranger looking apparatus aids in studying the many skulls in the large Western Reserve collection. Known as a craniostat, it suggests, at first glance, a huge metal tuning fork turned prongs-down on a heavy metal base. Attached to it are arms and rulers, moved by cogs and thumbscrews. By the use of the craniostat, the investigators can determine the exact measurements of any skull placed inside.

Bones grow just as a tree branch grows. Minerals, chiefly calcium, circulate through the bones. Blood vessels penetrate them. When illness or injury interferes with these normal processes, the bone growth is interrupted and frequently a scar is formed.

Tracing such scars to their causes has been an absorbing part of the work of the scientists of the Brush Foundation.



Dr. T. Wingate Todd using a craniostat, an instrument developed at Western Reserve University for determining dimensions of skulls

In one case, an anesthetic administered to kill pain during a minor operation caused a scar on the bone of a sickly child's leg. In another instance, X-ray pictures of a 3½-year-old girl revealed a dramatic and tragic story imprinted on bone, showing how even experiences that are purely emotional in character can leave an indelible impression on the future growth and development of the body.

At the age of two, the pictures showed, she had suffered some illness or injury. Yet, inquiry revealed that none of the usual ills of childhood had interfered with her health at that time. Further investigation solved the mystery. When the *(Continued on page 107)*

TESTS OF MENTAL TRAITS

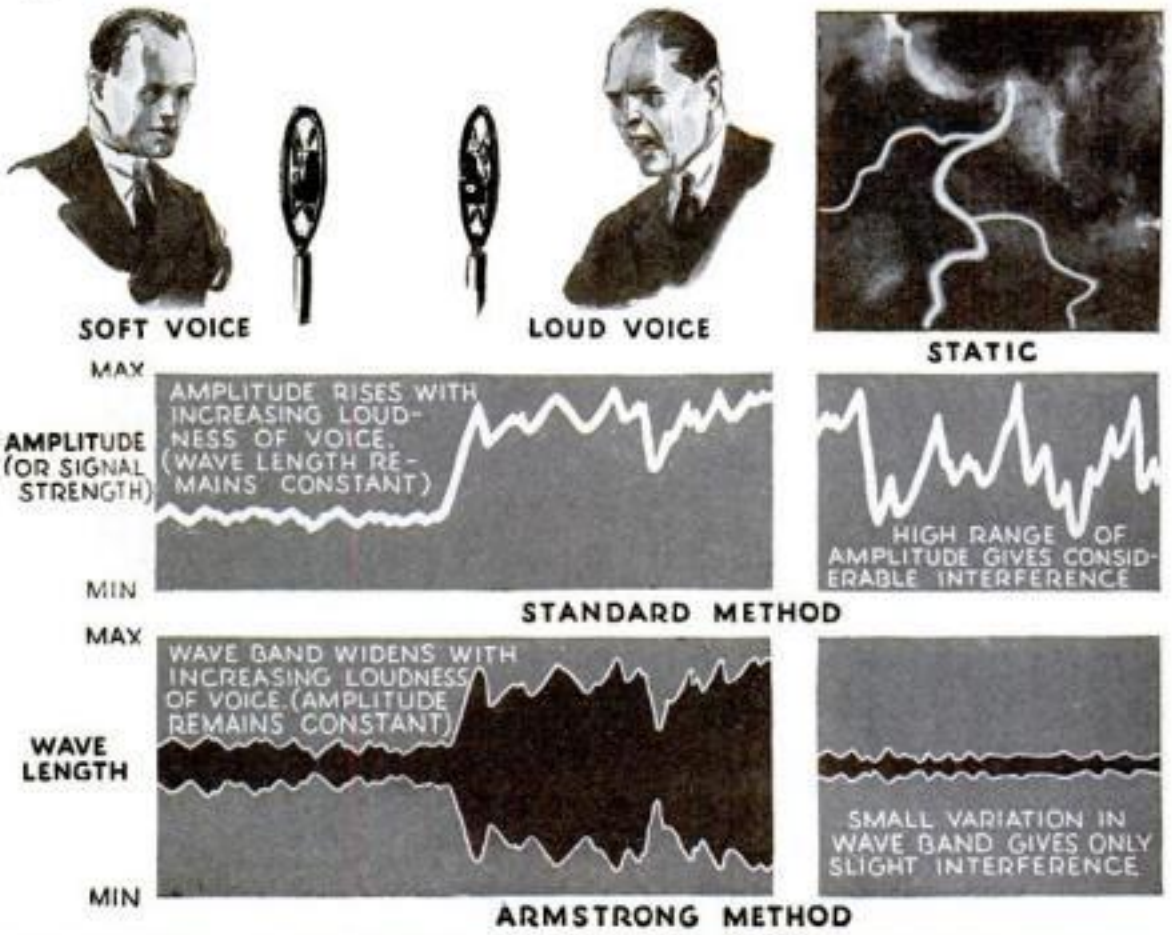
The youngster at the right is hanging numbered checks on hooks in a test of small-muscle ability. Below, a girl is holding a needle in a hole in the disk to demonstrate her steadiness of nerve

Dr. Carl Francis, of the Brush Foundation, applies calipers to a boy's leg to assure accurate measurement of it

New Radio System Eliminates Static

A STATIC-FREE system of radio transmission that turns accepted principles topsy-turvy has just been announced by Major Edwin H. Armstrong, one of America's leading radio engineers. Ready for immediate service in point-to-point communication, its use may eventually be extended to general broadcasting, where it would render conventional radio sets virtually obsolete. Advantages foreseen, however, are that it would wipe out static, tube noises, and fading; would make ultra-short-wave broadcasting practical; would pave the way for television stations linking all parts of the country; and would permit the transmission of musical programs of a quality unattainable in present-day broadcasting.

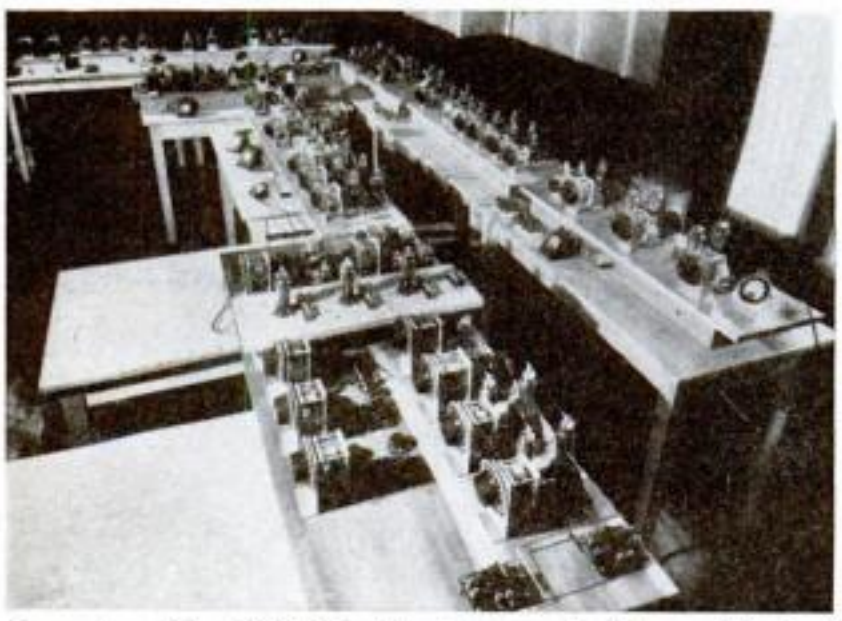
The Armstrong system employs a basically new method of imprinting the pattern of voices or music upon radio waves—in technical language, "modulating" them. Heretofore, variations in loudness as a speaker shouts or whispers have been translated into radio waves of corresponding amplitude, or strength, which are reconverted by home receivers into the loud and soft sounds. In contrast, the new system, using waves of unvarying strength, translates loudness gradations into fluctuations in the width of a whole band of wave lengths on which the transmitting station operates. Thus, while present-day broadcasters strive to maintain a fixed wave length, the new "frequency modulation" system does just the opposite. The 150,000-cycle range required, impractical at ordinary broadcast wave lengths, becomes feasible on ultra-short waves; and a new type of receiver makes the new signals audible.



The drawing explains the principle of the revolutionary new system which may banish static

Squawks and growls of static, caused by natural radio waves resembling ordinary broadcast waves, are banished in the new system; nature cannot imitate the peculiar wave pattern used. Unwelcome noises originating within the electrical circuit of the set itself, particularly troublesome in short-wave radio, are also suppressed.

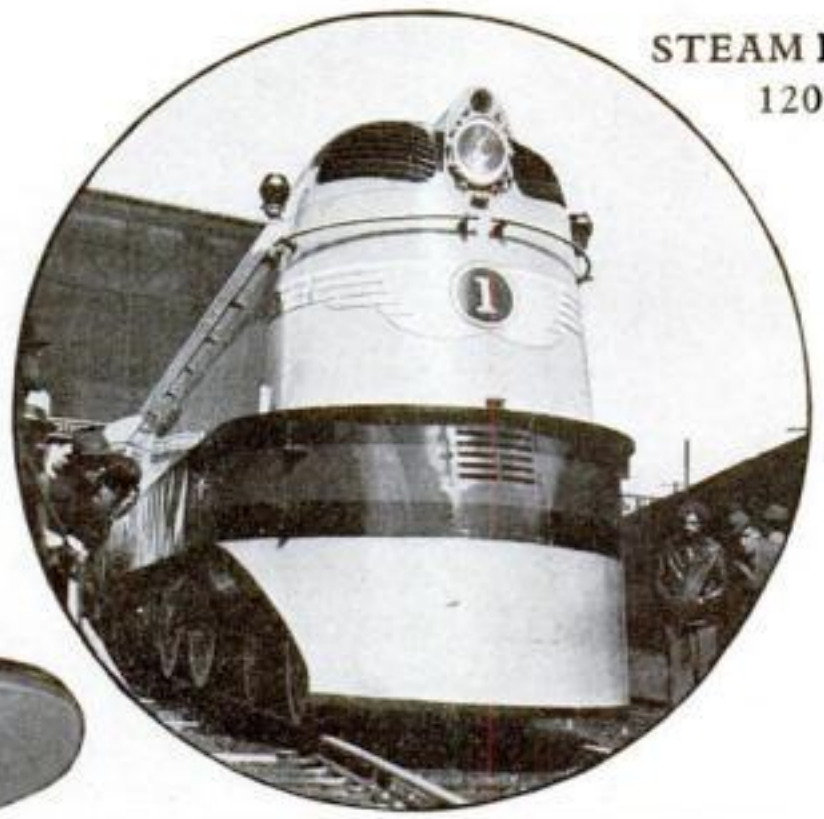
Because of its attractions, the "frequency modulation" system was proposed more than twenty years ago. Experimenters tried vainly to make it a workable method until, last year, Major Armstrong obtained such promising results that a short-wave transmitter atop the Empire State Building was placed at his disposal. Tests went on secretly for months, unnoticed except by amateurs. A receiver at Haddonfield, near Camden, N. J., picked up the two-kilowatt transmitter clearly at times when fifty-kilowatt New York stations were drowned out by static.



Apparatus with which Major Armstrong conducted secret tests of his new system atop the Empire State Building in New York City

ROLLER SKATES BUILT INTO SOLES OF SHOES

SHOES with built-in roller skates are the creation of a Madison, N. J., inventor. Front and rear rollers made of hard rubber are readily locked in place, for use, on a metal track running lengthwise along the bottom of the sole. When the skater tires of the pastime, both rollers slide back into a recess in the heel, where they fold out of sight, and the convertible shoes may then be used for walking.



Nose of the new oil-burning steam locomotive which is expected to set new speed records in transportation by rail

STEAM LOCOMOTIVE WILL GO 120 MILES PER HOUR

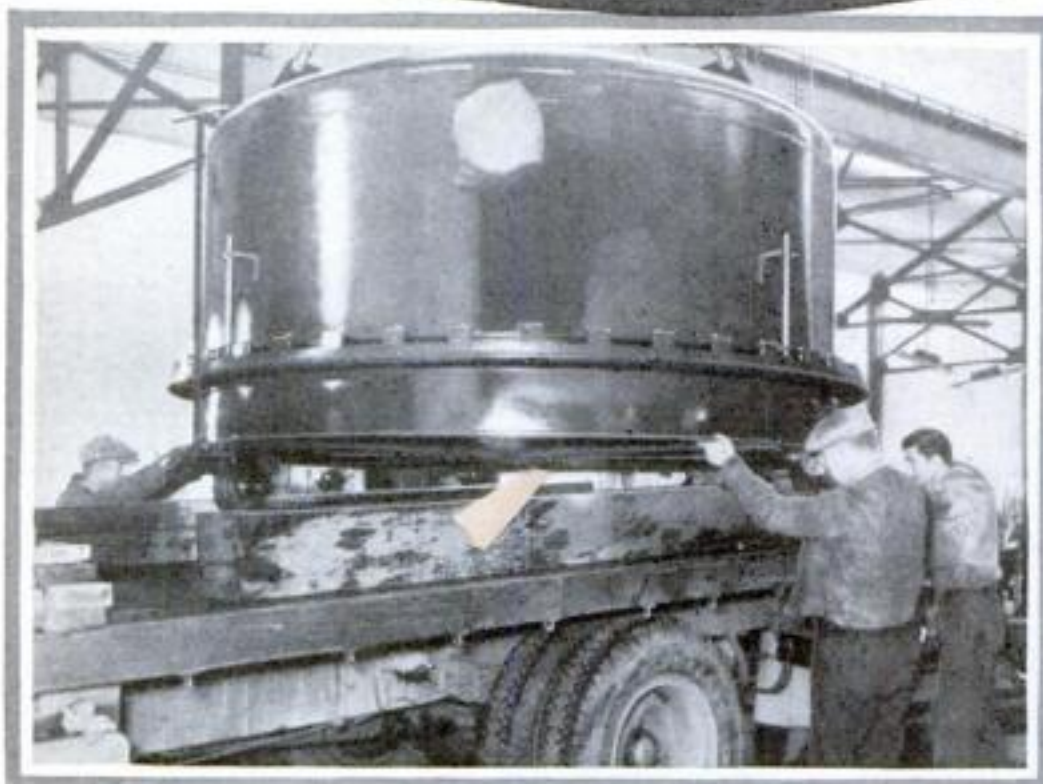
CALLED the fastest in the world, a steam locomotive just completed at Schenectady, N. Y., is declared to be capable of a speed of more than 120 miles an hour. The streamlined giant will shortly go into service on the Chicago, Milwaukee, St. Paul & Pacific Railroad, where it will maintain a 6½-hour schedule between Chicago and the twin cities. Burning oil, it develops a relatively high steam pressure of 300 pounds to turn the seven-foot drivers. Roller bearings reduce friction, permitting quick and smooth acceleration, and no oiling or greasing will be required along the engine's run. Its brilliantly colored shell, painted yellow, red, and gray, gives the locomotive a striking appearance.

Aluminum-Coated MIRRORS

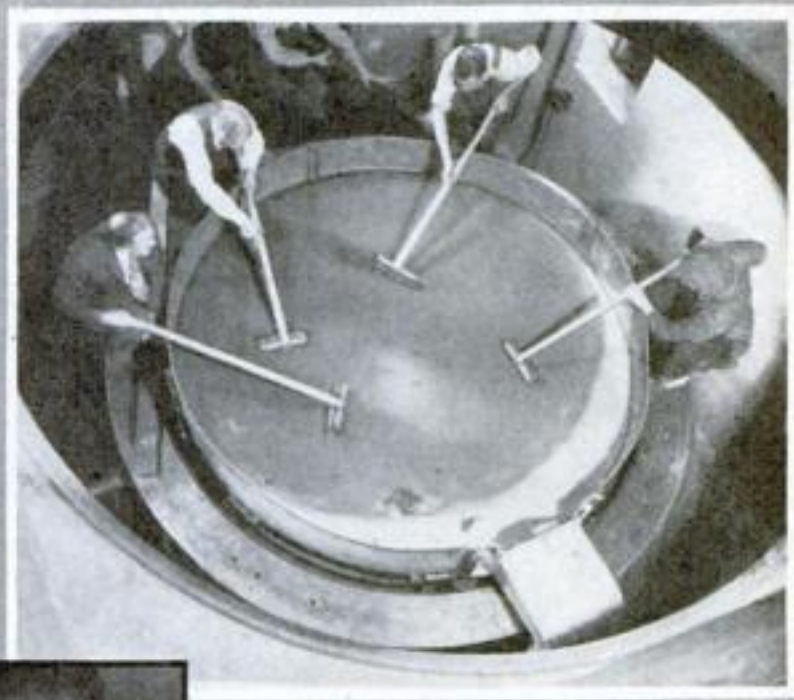
BOOST POWER OF GIANT TELESCOPES

The 100-inch mirror of the famous telescope at the Mt. Wilson observatory, with its aluminum coating that greatly increases the power of the instrument

Right, the opening through which the giant telescope now peers farther into space than ever before, thanks to its shiny new reflector



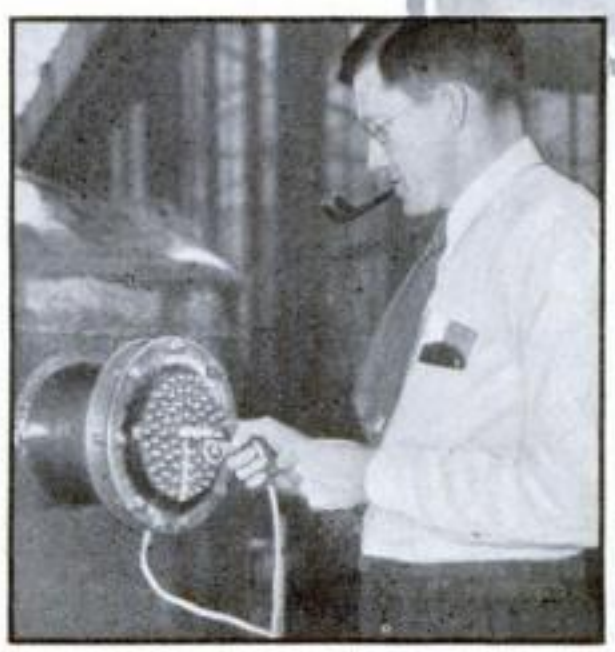
The nine-foot-diameter "vanity case" in which the mammoth mirror received its resurfacing treatment, on a truck for transportation to the observatory



Formerly, men with swabs had to resilver the mirror twice a year, as shown in this picture

ASTRONOMY'S biggest "eye" in service today—the famous 100-inch telescope at Mt. Wilson Observatory in California—now peers farther into space than ever before. Its great mirror has had its face lifted. A shiny coat of metallic aluminum, applied by a new process, replaces the silvering that hitherto has covered the big glass disk.

The aluminum coating reflects as much as fifty percent more light than silver, trials with smaller mirrors have shown. When Mt. Wilson scientists tested the treatment on the sixty-inch mirror of their second largest telescope, they were startled to find its performance as good as that of their prized 100-inch instrument, which cost nearly a million dollars more; and they hastened to "aluminize" the latter to boost its power in turn. Experts predict the aluminum process will be used to coat the 200-inch mirror recently poured at Corning, N. Y., giving an instrument of far greater power than science dreamed of obtaining.

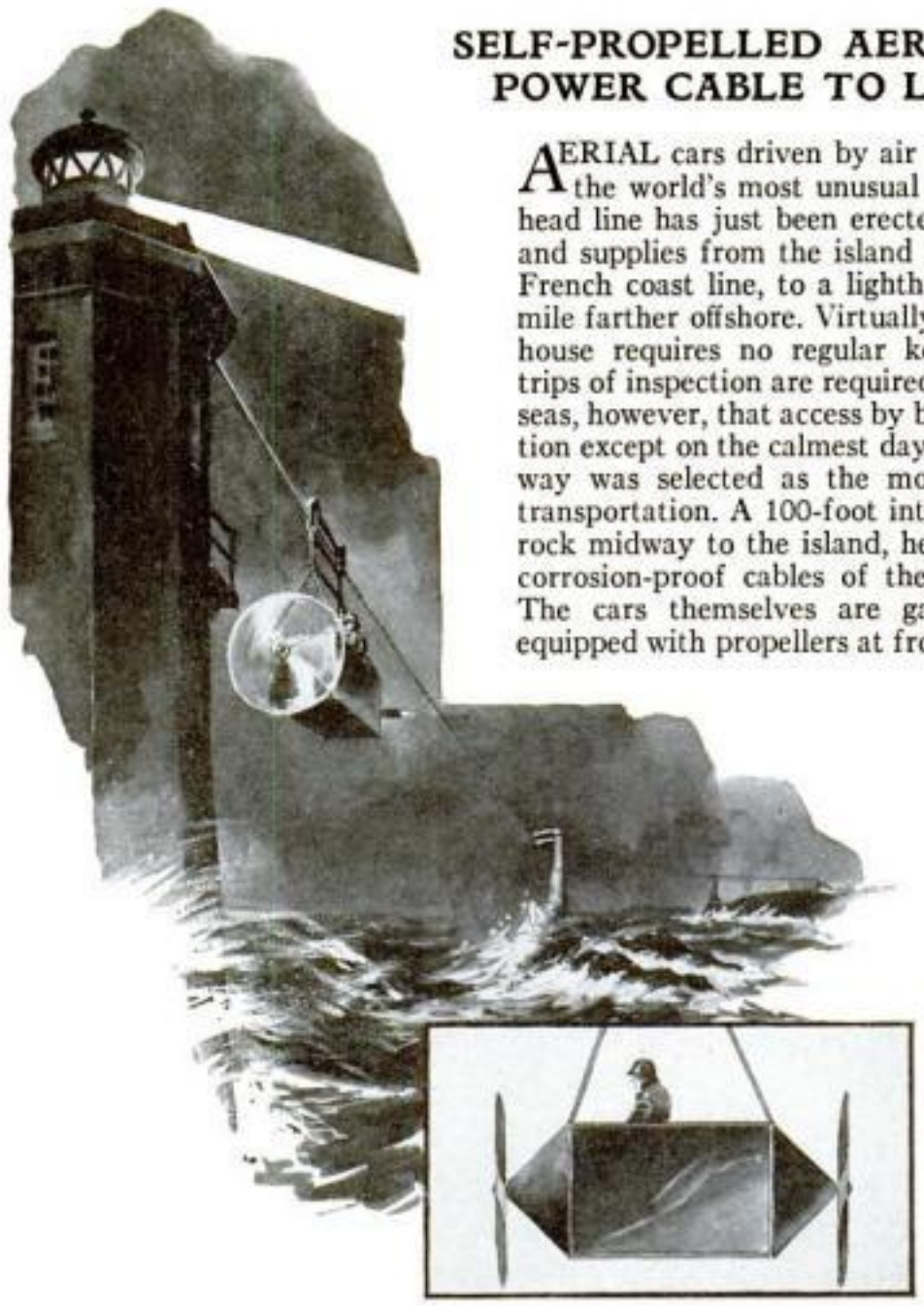


This switch sends electricity into a vacuum chamber to vaporize aluminum and coat mirror

To form the aluminum coating, the mirror disk is placed in a huge vacuum chamber and the air is pumped out. Then, pieces of aluminum are vaporized within the chamber by electricity. Atoms of the metal adhere to the surface of the glass, forming an aluminum film that will last for years. Hitherto, it has been necessary to resilver the large Mt. Wilson mirror twice a year, since its silver became tarnished by contact with the air.

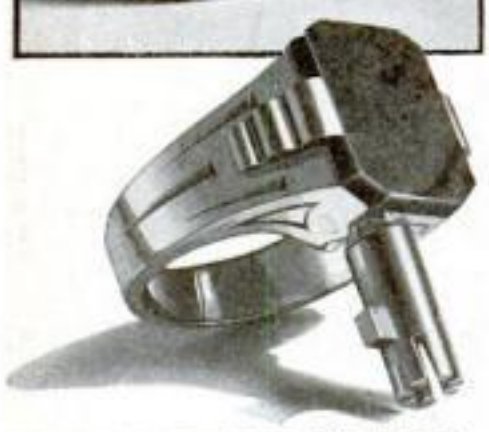
SELF-PROPELLED AERO CARS RIDE POWER CABLE TO LIGHTHOUSE

AERIAL cars driven by air propellers ride one of the world's most unusual cableways. The overhead line has just been erected to carry repairmen and supplies from the island of Ouessant, near the French coast line, to a lighthouse on a rock half a mile farther offshore. Virtually automatic, the lighthouse requires no regular keeper, but occasional trips of inspection are required. So turbulent are the seas, however, that access by boat is out of the question except on the calmest days of the year. A cableway was selected as the most feasible means of transportation. A 100-foot intermediate pylon, on a rock midway to the island, helps support the fixed, corrosion-proof cables of the suspended tramway. The cars themselves are gasoline-propelled, and equipped with propellers at front and rear. By coupling one or the other of its propellers to the motor, a car is made to run forward or backward as desired. A brake, acting on the fixed cable, provides a means of stopping quickly. The cables also serve to convey 15,000 watts of electrical energy to the beacon and other equipment of the lighthouse, including an air compressor that operates an ear-piercing fog siren when visibility is poor.



LIGHTS WARN RACERS OF TROUBLE ON THE TRACK

TRAFFIC lights for auto racers are an innovation at the Indianapolis Motor Speedway, where sets of yellow and green lights have been installed at intervals along the course. The green lights burn as long as the track is clear. In case of trouble, the lights change to yellow and the racers slow down until the signals turn green again. The photograph shows a set of the lamps on a footbridge across the straightaway.

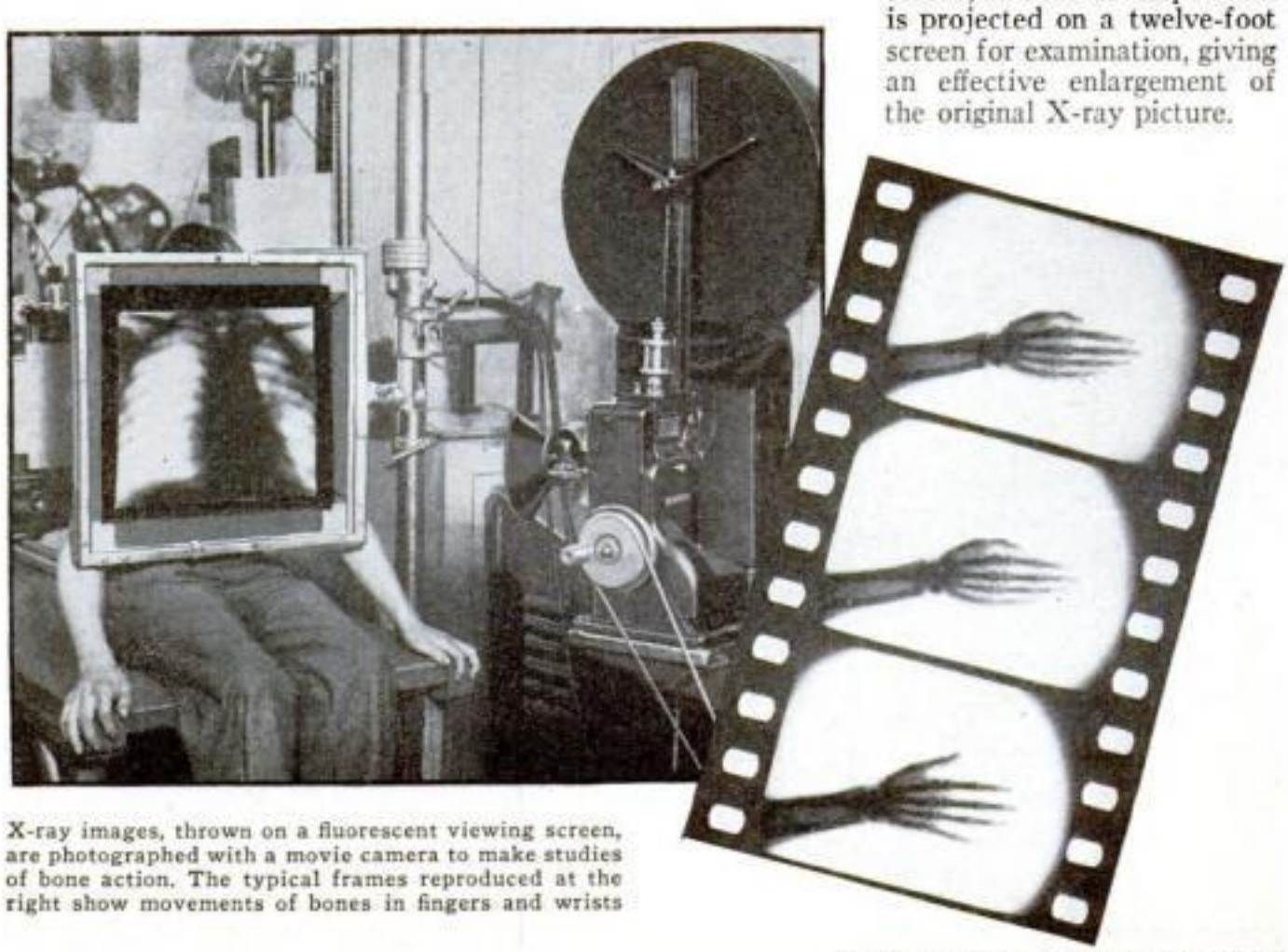


KING'S RING HOLDS HIDDEN PASS-KEY

RINGS worn by royalty have played a romantic part in history, but a modern monarch, King George V of England, will soon make use of one with a thoroughly practical purpose. The unusual accessory contains a master key that opens the doors of a suburban house just completed for the British sovereign. For use, the ring is slipped from the finger and the key extended, as shown immediately above; at other times the key lies folded within the ring.

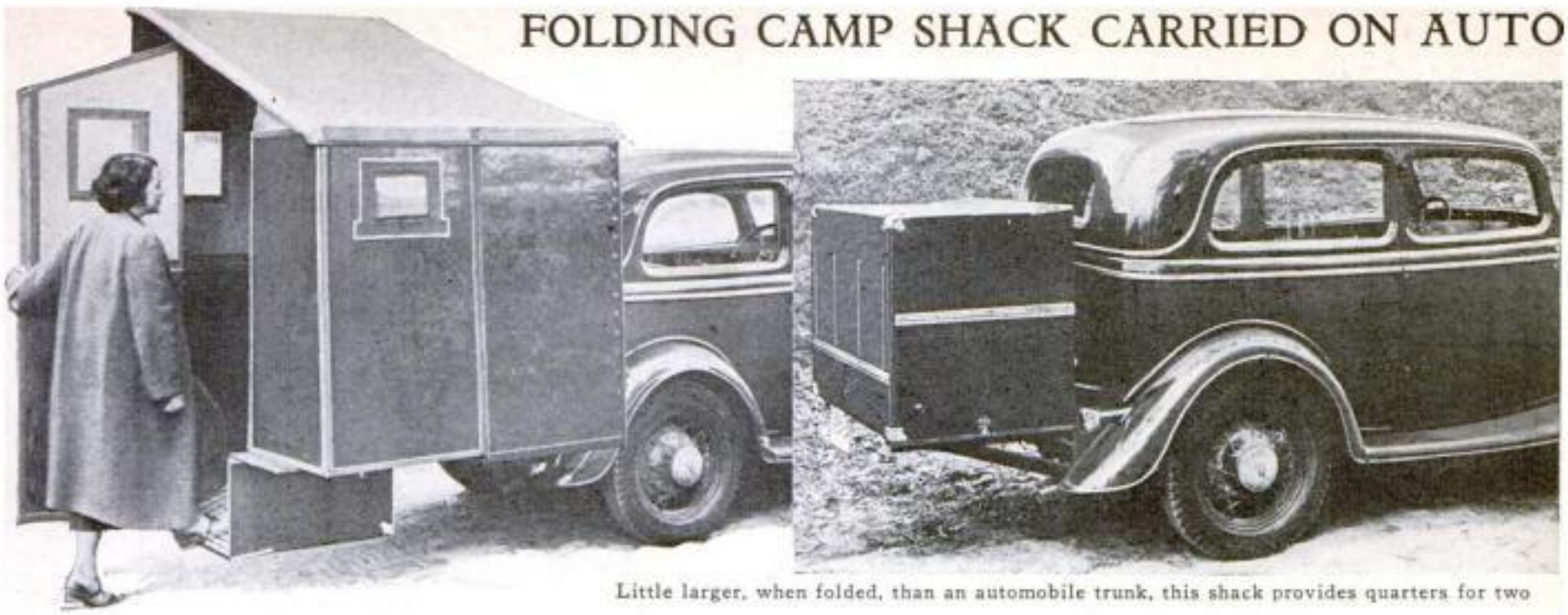
X-RAY MOVIES AID IN WAR ON DISEASE

X-RAY movies, first demonstrated by German pioneers several years ago and now developed to a point well past the experimental stage, are helping physicians to fight disease at the Victoria War Memorial Hospital in England. The new technique, as used in practical medical work, permits the filming of the bones and internal organs in action. One of its most important applications aids patients with joint diseases; for example, it is now possible to take motion pictures showing the action of the bones as a patient flexes his wrist, and, by comparing films made over a period of time, to observe what progress has been made toward recovery. A movie camera photographs the X-ray images appearing on a standard fluorescent viewing screen, and the developed film is projected on a twelve-foot screen for examination, giving an effective enlargement of the original X-ray picture.



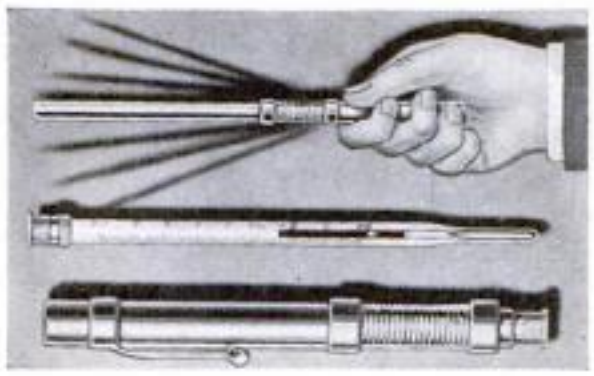
X-ray images, thrown on a fluorescent viewing screen, are photographed with a movie camera to make studies of bone action. The typical frames reproduced at the right show movements of bones in fingers and wrists

FOLDING CAMP SHACK CARRIED ON AUTO



Little larger, when folded, than an automobile trunk, this shack provides quarters for two

SETTING a new mark in compactness, a folding shack for tourists and campers occupies little more space, when closed, than an ordinary automobile trunk, and is carried as easily on the back of a car. When unfolded at an overnight stop, it opens to ten times its former size, as shown in the photographs. Within the roomy quarters, two cots are arranged as upper and lower berths. Other fittings include a table, a lamp, two windows, and a step for convenience in entering.



CASE HELPS TO SHAKE CLINICAL THERMOMETER

A "MECHANICAL WRIST" built into a new case for a fever thermometer saves effort in shaking down the mercury, and lessens the chance of breaking the instrument. When the spring handle is given an easy to-and-fro motion, the thermometer rocks back and forth, tapping against a metal seat. A few swings are sufficient to bring the mercury column below "normal."

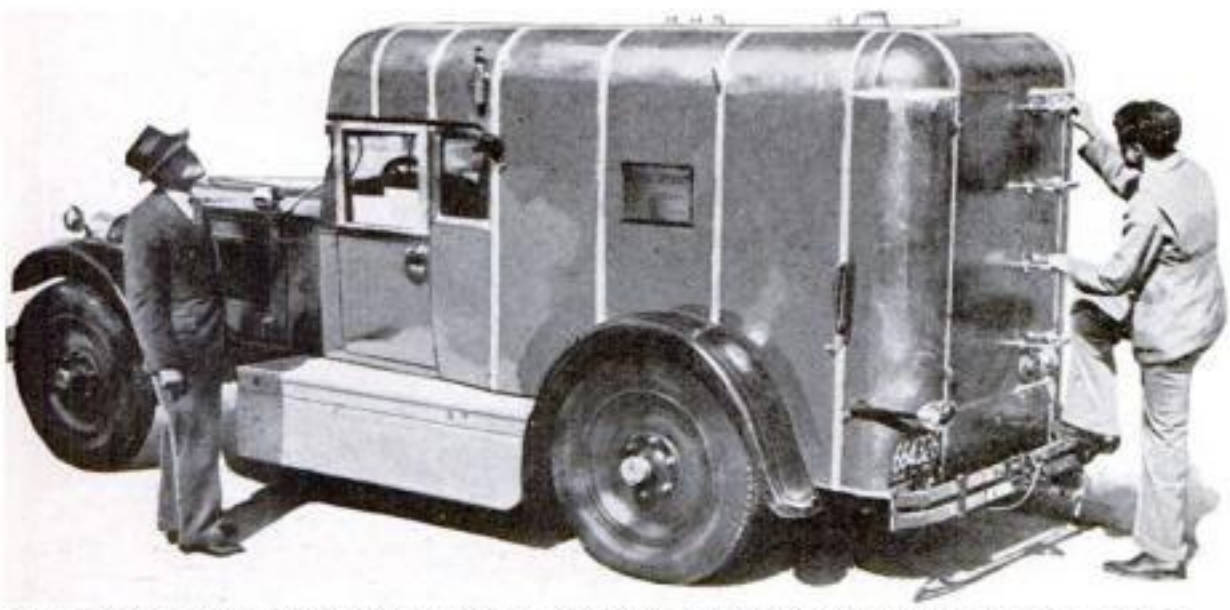
MOTOR-CYCLE ENGINE RUNS CULTIVATOR

FROM an old motor cycle and a few scrap parts, an ingenious home mechanic recently constructed the serviceable cultivator illustrated. Power from the engine, transmitted to the wheels through reducing gearing, propels the machine at speeds of from two to six miles an hour. An ignition switch and a clutch lever are conveniently placed on the handles, which are fashioned from one-inch pipe. A fan cools the motor to prevent overheating. The owner reports that his homemade machine will harrow, plow, and cultivate rows of any size. The photograph at the right shows the ingenious machine in operation.

This homemade cultivator can go as fast as six miles an hour, and will harrow, plow, or cultivate any size rows

SHEATHED CAR STUDIES RADIO ECHOES

Resembling the armored cars that transport valuables through city streets, a traveling radio laboratory has just been placed in service by Harvard University experimenters. The copper-sheathed vehicle is equipped with especially designed receivers and an ultra-high-frequency transmitter, and will be used in studying radio echoes that seem to "bounce" from a reflecting layer situated many miles above the earth.



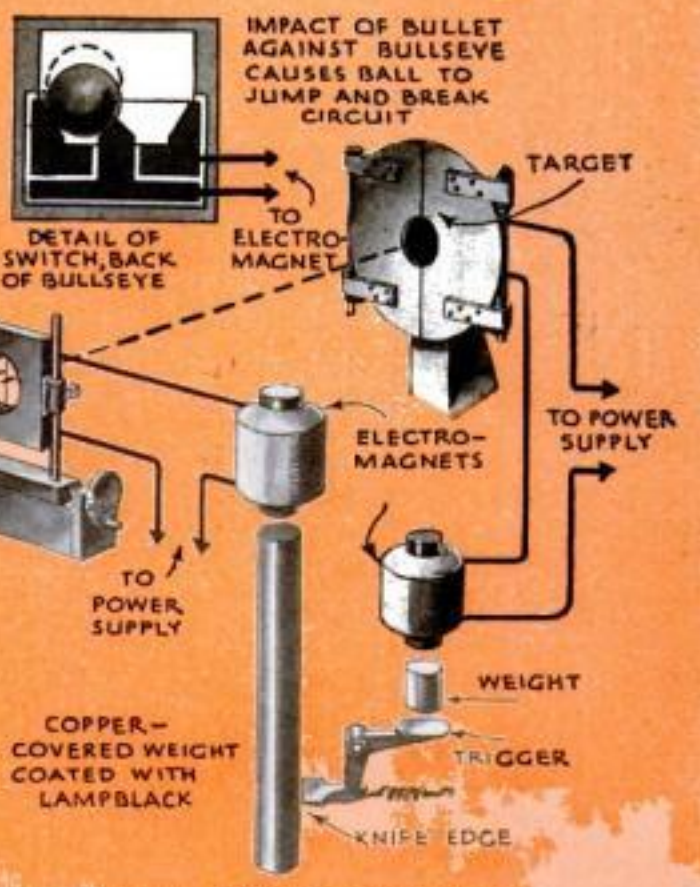
In this copper-sheathed traveling laboratory, scientists will investigate mysterious radio echoes

HEELS ARE REVERSIBLE

REVERSIBLE rubber heels for shoes are a recent German invention. When the wearer of a pair of shoes fitted with these heels finds them run down, he has only to slide them from their sockets as shown above, turn them over, and replace them, thus obtaining a new wearing surface. After both sides are worn down, the heels may be discarded and others put on.

Scientific Shooting Gallery

REVEALS SECRETS OF GUNPOWDER



With this complicated apparatus, **ballistic engineers** can measure the average velocity with **which a bullet** travels

AS THE MICROSCOPE SEES IT
These photomicrographs show, from left to right, rifle-powder grains, pistol powder, and powder for shotgun shells

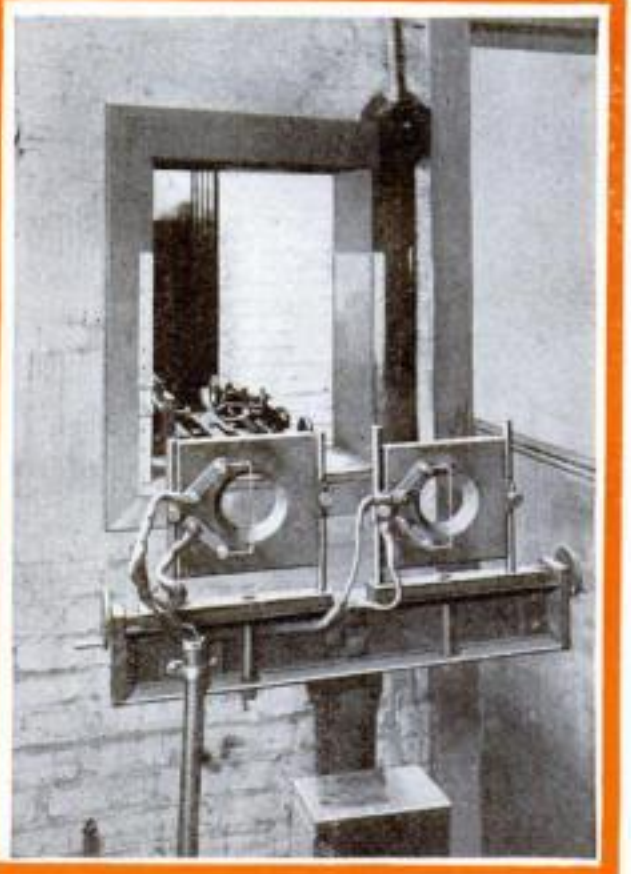
DID you know that the position in which a cartridge lies just before being inserted into a rifle may influence the course of the bullet? Or that a bullet will move faster, when it leaves the gun, if it is fired up into the air instead of downward? That huge quantities of smokeless powder have been stored beneath the cold waters of mountain lakes? That grains of smokeless powder for some guns are as large as your thumb? That smokeless-powder grains for small arms are black because of a graphite coating which prevents static electricity from igniting them?

These are but a few of the strange facts that you could learn if you were to visit a modern powder-research laboratory. But perhaps the most amazing of all would be the discovery that gunpowder is a sort of contradiction of itself. It is so absolutely dependable that a misfire of a cartridge caused by failure of the powder is extremely rare, yet powder has resisted the efforts of science to put it into a harness of figures and formulas. Even now, the most reliable method of determining the behavior of a given quantity of powder is that of trial and error, although modern scientific methods of measurement are bringing about a clearer understanding of its qualities. This is one reason why a powder-research laboratory is an interesting place to anyone who is fond of shooting.

Across the river from Wilmington, Del., is such a center of interest. It is the Burnside Laboratory of the smokeless powder department, E. I. du Pont de Nemours & Co., the place where modern gunpowder has been persuaded to give up many of its secrets. It is there that ballistic engineers and chemists have made some interesting observations on the behavior of powder, ammunition, and guns.

For instance, it was observed that different ballistic results were obtained when different operators fired a rifle mounted in an aim-testing device called a machine rest. Investigation revealed that there was a difference in the way the cartridges were handled just before shooting. Further study brought to light several facts which may be of interest to the amateur marksman, sportsman, and anyone else who uses ammunition of medium or large size.

When a cartridge is being loaded with powder at the factory, a small amount of free space generally is left in the powder compartment so that, when the bullet is pushed into place, there will



Part of the apparatus used in velocity tests. The bullet severs a copper wire as it leaves the gun, thereby breaking an electrical circuit

be no danger of its jamming against the powder grains. Therefore, by twisting and turning the cartridge, the powder can be made to change its position slightly. If the cartridge is held with bullet end upward, and tapped gently on the back of the hand, as one would tap a cigarette, the powder will be compacted at the base. If the cartridge is held bullet end down, the powder grains will mass themselves against the bullet. If the cartridge is laid on a flat surface, or placed between the hands and rolled, the powder will be distributed uniformly from one end to the other.

When the firing pin strikes the primer, a jet of intensely hot and fast-moving flame is projected through the powder mass. If the powder grains are close to the jet, they will be ignited more quickly than if the primer flame has to move a greater distance before striking the powder.

All of which leads to the following deductions: If the powder is distributed evenly by rolling the cartridge, normal ballistic results may be obtained. If it is compacted at the primer end, either in the manner described or by holding the gun upward, the pressure will be raised, with a consequent increase in bullet velocity, and a flatter trajectory. If it is concentrated at the bullet end, by tapping, or by pointing the gun downwards, a lower pressure, lower velocity, and more curved trajectory result.

The importance of the distribution of powder within the cartridge may be appreciated when it is realized that the velocity of a .30/06 bullet shows considerable variation, depending upon the manner in which the cartridge is handled. Proper handling of the cartridge after tapping or rolling is quite important. It should be moved evenly and slowly into a horizontal position, and inserted into the firing chamber without jarring. A jerk will cause the powder to be dislodged, and will cancel the effectiveness of the previous treatment. Although this is of little importance when shooting over short ranges, it might be noticeable in firing at longer ranges with high-velocity ammunition. This effect does not apply to .22-caliber ammunition, because of its smallness, or to shotgun shells and other cartridges not containing powder in loose form.

It is unlikely that the average shooter realizes the high degree of reliability of his powder. He is so accustomed to having every cartridge fire when he pulls the trigger that he takes for granted the dependability of his ammunition. When ammunition is blamed for a misfire the real reason usually can be found in some part of the firearm; the failure is more likely to be mechanical than chemical.

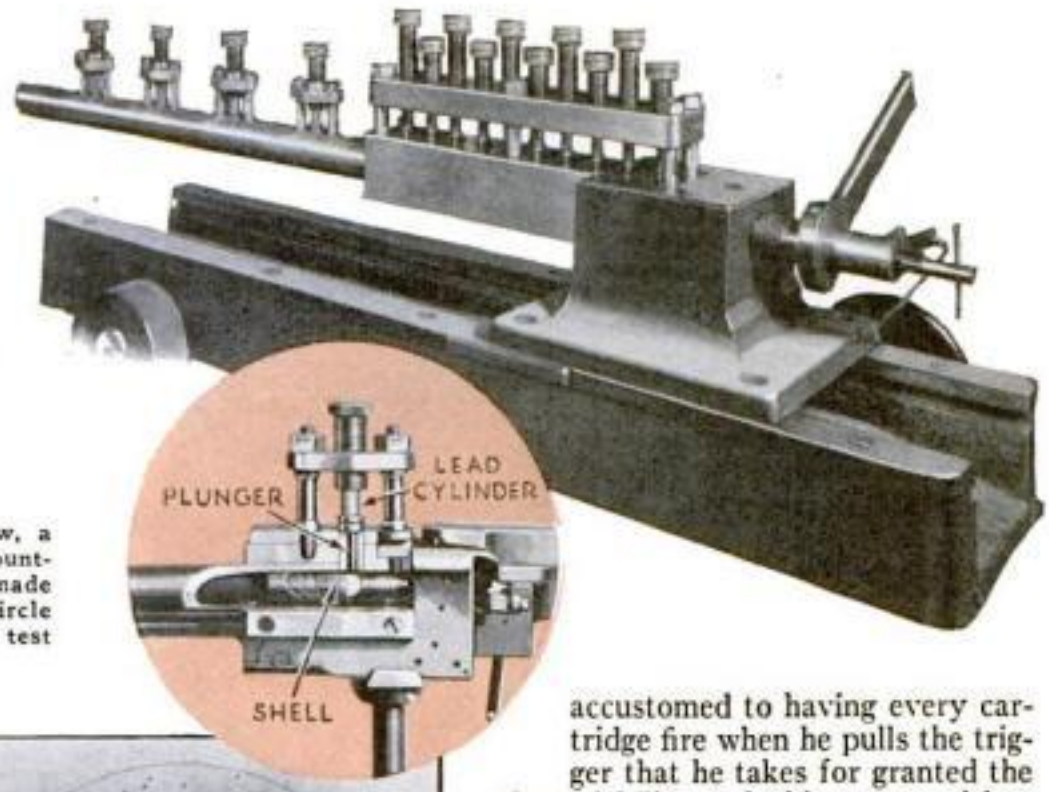
When a scientist attempts to study gunpowder, he finds that he is facing various difficulties. Try to visualize one one-thousandth of a second. You will find it impossible. Your mind simply cannot grasp a time interval so small. A series of motion-picture images, which generally are presented to your eyes at the comparatively slow rate of sixteen to twenty-four distinct pictures a second, give the effect of continuous action. A scientist working with gunpowder is concerned with chemical reactions which occur in less than a thousandth of a second. To photograph a bullet that such reactions send through the air, he must use a camera with a shutter speed of something like one millionth of a second.

Consequently, the burning of the powder must be studied by use of such delicate instruments as the cathode-ray oscillograph and the piezo-electric gauge, which operate with more than lightninglike rapidity. Because of the extreme speed of the chemical reactions which occur when smokeless powder is burned, the temperature rises to a high point and returns so quickly that it cannot be measured directly. The time-pressure measurements, and a knowledge of the chemical relationships, enable the scientist, however, to calculate such values accurately. When a cartridge is fired in a gun, an almost endless number of variable factors affect the motion of the bullet. The manner of ignition, heat absorption of near-by metal, effectiveness of the gas seal between the bullet and barrel, friction effects, type of rifling, and a long list of other matters all are important.

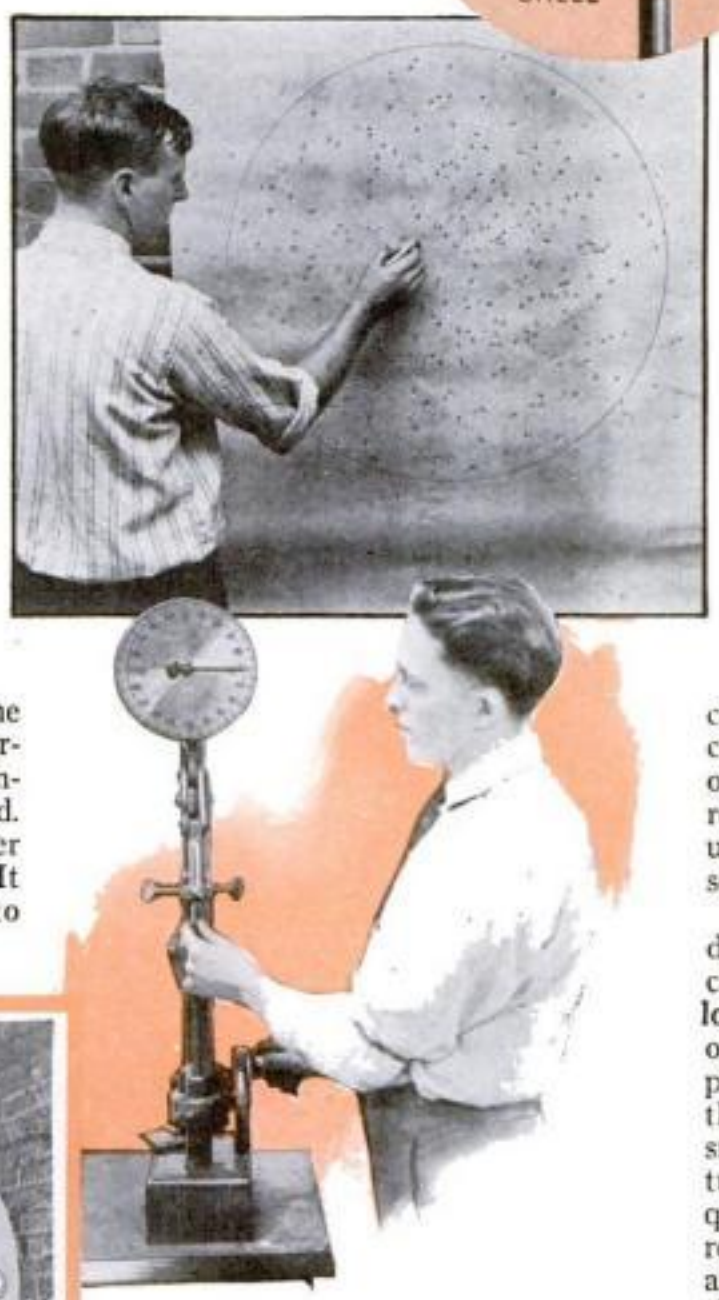
The common method of measuring pressure developed by a charge of powder is an old one, yet is sufficiently accurate for routine tests. To make a pressure-testing set-up a hole is drilled in a standard rifle barrel a short distance from the rear end of the cartridge chamber. This distance will vary for guns of different caliber; it is exactly one inch for a .30/06 cartridge for the Springfield rifle. In this hole is placed a bushing which carries a hole in which *(Continued on page 105)*

MEASURES BARREL PRESSURE

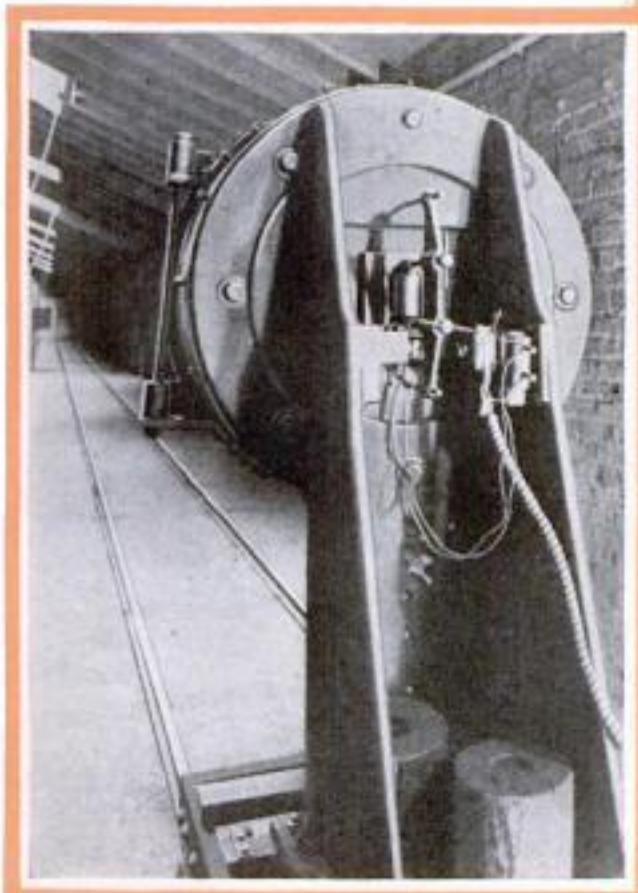
The strange device at the right is a multi-piston gauge for measuring pressures at the various points on a gun barrel. As shown in circle, a lead plunger compresses a cylinder of lead to indicate the pressure set up by the powder



In the picture below, a research worker is counting the shot holes made in a thirty-inch circle in a shotgun-powder test



The force needed to pull a bullet from a cartridge is measured by this machine



A rear view of the velocity-test target, showing the disjunctor which causes an electric circuit to be broken when the bullet strikes the bullseye

Behind the Scenes of British Radio

WHEN buildings crash, airplanes drone, or motor cycles roar, in a radio drama, the source of the sound is seldom what it seems to listeners-in. Pictures on this page show the ingenious means employed by British broadcasters to make their programs realistic. The illustrations contrast the effect obtained with the artifice, often a surprisingly simple one, employed by the radio technicians to produce it. Experiments determine the placing of the microphone for proper volume.

ROAR OF THE WAVES. A drum containing lead shot, slowly rocked before the microphone, gives a very realistic imitation of what the wild waves say as they beat on the shore

A RADIO EARTHQUAKE. The terrifying rumble of an earthquake, as you hear it on the radio, may come from bricks sliding down a sanded board onto the head of a bass drum

A HEAVY RAIN
When the script calls for a pouring rain, the illusion is produced by pouring rice into a basket filled with crumpled paper, as is shown above

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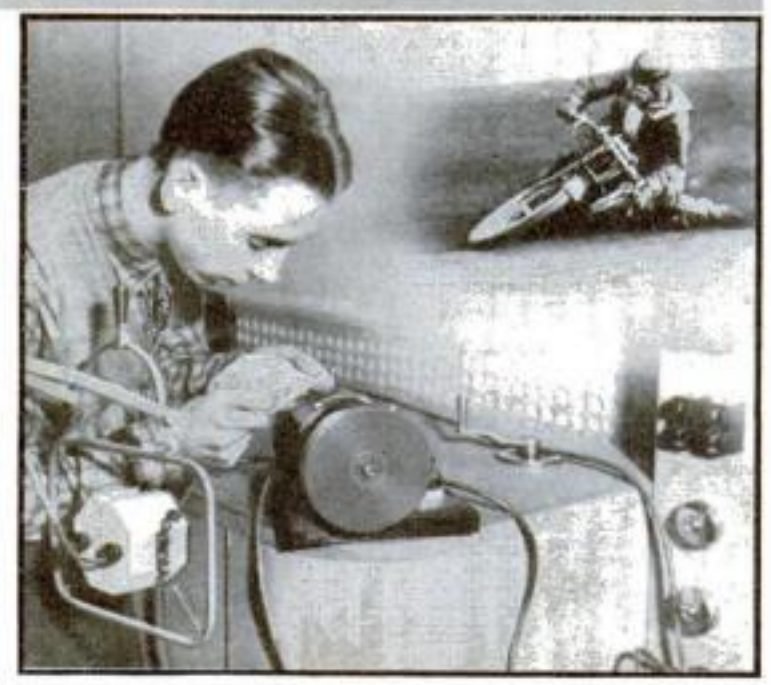
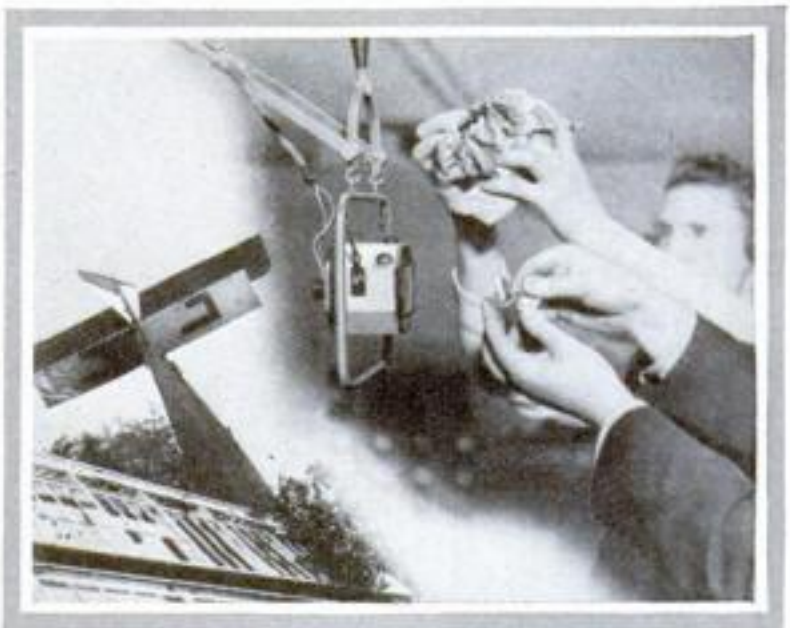
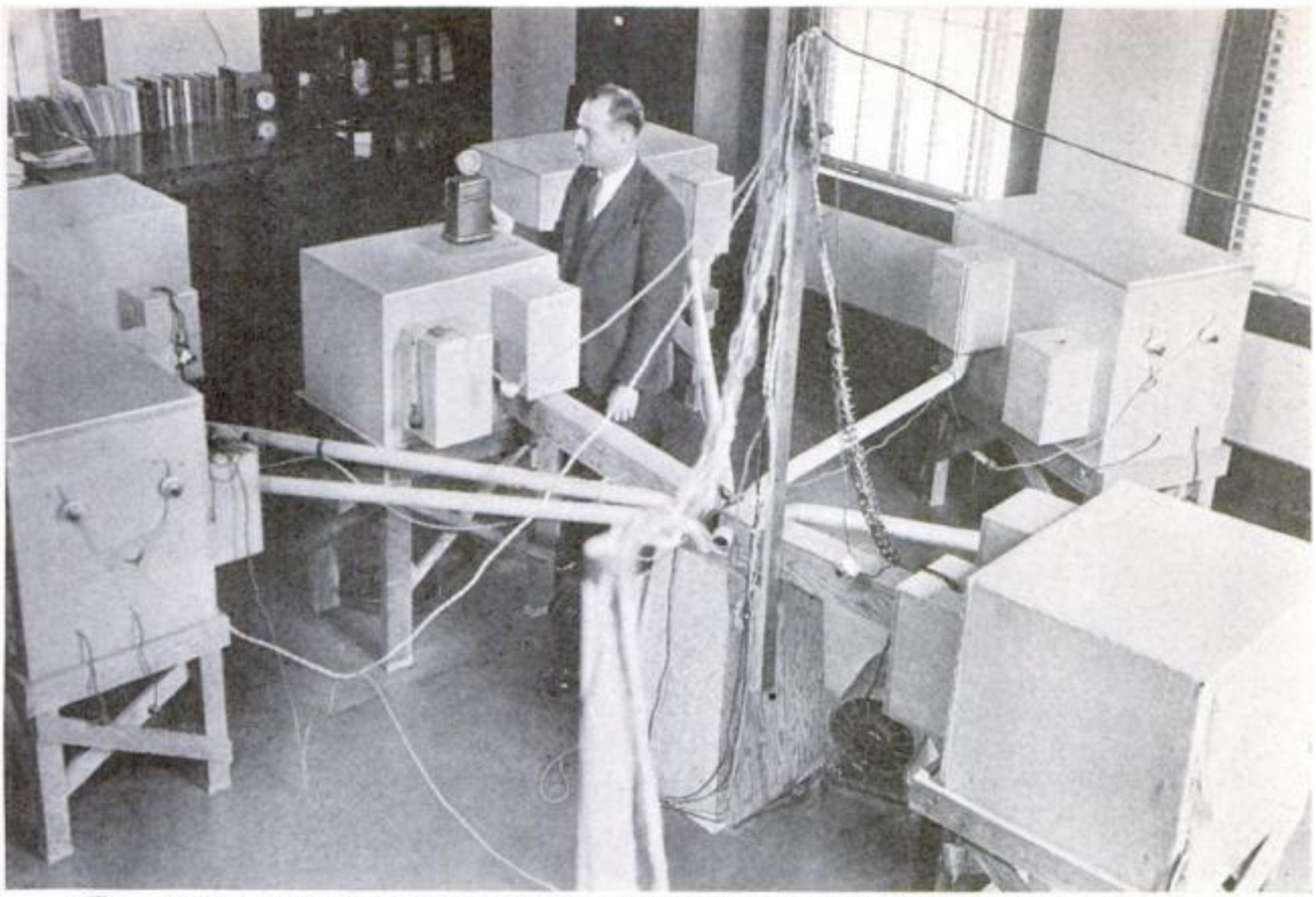
MOTOR CYCLES
The noise of a racing motor cycle is simulated by holding a piece of heavy paper against a revolving disk bearing thongs of leather





AIRPLANE NOISES. To reproduce the sound of an airplane crash, radio technicians smash a match box and tear heavy paper close to the microphone, as in the top picture. The drone of a flying plane is imitated by holding a drum so that its head is struck by thongs on a revolving disk



In these soundproof cages, baby canaries were raised for studies in psychology. The air pipes have baffles to trap sounds

Curious Tests *with* Canaries

SOLVE MYSTERIES OF HEREDITY

DOES your success in life depend upon the brains you are born with, or upon the things you are taught as you grow older? Canary birds, living in the padded depths of soundproof cages in the University of Southern California's psychological laboratory, are helping scientists to find the answer. In a series of remarkable tests, of which the first has just been completed, the canaries are ending a long-standing controversy by showing what relative parts heredity and environment play in shaping the traits of an individual.

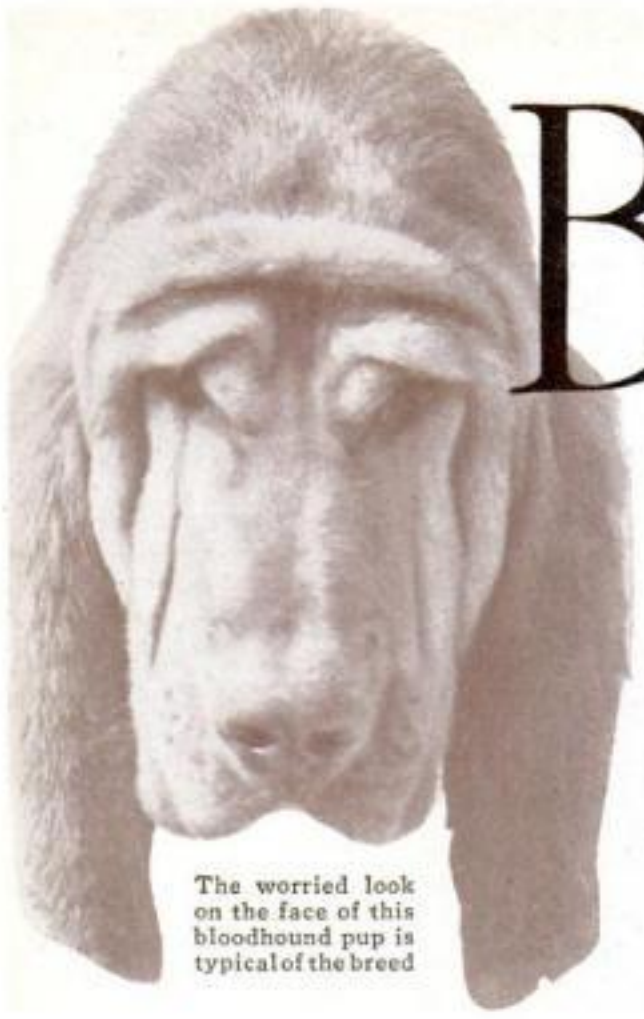
In their first test, investigators sought to determine how canaries learn the complicated songs known as "rolls" and "tours." Do the baby birds imitate the songs they hear their parents sing, or is their singing ability inborn? Experimenters placed a dozen infant birds, almost as soon as hatched, in padded cages where no sound could enter. Air-conditioning equipment made artificial weather, supplying warmed or cooled air to the cages according to the season. Baffles trapped any sounds that might enter through the air pipes. Each cage contained a microphone, enabling the scientists to eavesdrop upon the birds.

Months passed while an automatic sound recorder detected nothing but sporadic chirping. Then, virtually overnight, all the birds began singing. Headphones clamped to ears, the scientists listened spellbound to the complicated songs that delight canary lovers. To prove what they heard, they made records of the songs on phonograph disks. Here at last was proof that the laws of heredity held true, not only for physical attributes, but also for functions such as the ability to sing, to learn, or to think. Discoveries made in this and projected tests, the investigators forecast, may have far-reaching applications to problems of human life and behavior.

An experimenter placing a microphone in a cage to pick up bird songs. When the young birds began to sing, the notes were recorded on phonograph disks, as shown below

AMAZING FEATS OF Bloodhounds

By LEON F. WHITNEY



The worried look on the face of this bloodhound pup is typical of the breed

LATE one evening, last summer, a long-distance call reached me from Cromwell, Conn. A two-year-old baby had disappeared while its mother was picking blueberries, and 700 searchers had combed the fields without success. Would my bloodhounds join the hunt?

It was after midnight when Jack and Toughey, two of my best trailers, scrambled from the car at the scene. Like fireflies, the flash lights and lanterns of searchers were flickering in the fields beyond, and in front of the house for half a mile the road was solid with parked cars. It took us three hours to get the people back so the dogs could work unhampered. Then, I gave them a smell of the baby's sun suit and commanded "Find!" With noses to the ground, they started out.

The first step in trailing with bloodhounds is to give the dog a sniff of some article that has been handled by the person sought

When trailing begins, the holding strap is unhooked from the collar and snapped onto the harness, as shown above. In the picture at the right, the dogs' heads are being held up from the ground until they reach the spot where the lost person is known to have been at one time. This is done to prevent false starts

Trailing over a stone wall. For practice runs, boys are hired to lead the dogs over courses up to five miles, using every possible trick to throw them off the scent

A fast trail is usually a cross-country run. Try walking behind two tugging, 100-pound dogs, and your heels are jarred black and blue. With a State Police officer and the father of the lost child behind me, I skirted a nursery and entered a sand pit. Here, the dogs zigzagged and crisscrossed as though they had gone crazy. A few days before, the baby had played in the pit and the dogs were following the maze of tracks in the sand.

Suddenly, Toughey lifted his nose in the air, standing almost on tiptoe to sniff the breeze. Jack followed suit. A moment later, we were plunging across a field, through the nursery, and into the crowds surrounding the house. Tripping up and bowling over people who got in the way, the animals dived into the door and rushed into the building. Nearly half a mile away, and through the scent of more than 200 living people clustered outside the house, these wonderful dogs had caught the faint odor coming from the empty room where the child had been!

The baby was not in the house. The dogs came outside, started trailing through the crowd, traced the path of the child to the spot where the baby last was seen by her mother, then headed across a pasture toward a swamp. The night had turned cold and a fine drizzle was falling. Light was streaking the east when they crossed a bridge and veered into the reeds, tall ferns, and water. I knew we were very close to the child, from the way the dogs held their heads up and sniffed. We held them back until we could see a little better. The father called the baby's name over and over. There was no response. It seemed certain the child was drowned.

As soon as it was light, we found the baby a few feet away. She was sitting up to her waist in water, too numb to answer her father's call, but otherwise unharmed. Seven hundred searchers had not thought of looking in that direction, but the keen noses of the bloodhounds had trailed her and saved her life.

Nine times, last summer alone, my dogs found children and old people who were lost. Counting wild-goose chases, we were in action on an average of once every five days. The distance we covered in our runs must have totaled hundreds of miles.

Probably no animal in the world is more misunderstood than the bloodhound. In the popular mind, the animals are vicious brutes that trail and attack their quarry. As a matter of fact, they are among the most gentle, harmless dogs known. Trailing is a game with them, and they haven't the slightest ill will toward the ones they follow.

Several years ago, in Kentucky, a long search for a lost child ended with a dramatic exhibition of the inherent kindliness of the bloodhound.

A little girl was last seen playing with her pet dog near the bank of a river. At evening, the dog returned without the child. All night, the neighbors searched in vain and in the morning they began dragging the river. Twenty-seven hours after the disappearance of the child was discovered, Capt. V. G. Mullikin, in his lifetime one of the greatest bloodhound men in America, reached the spot with his celebrated dog, Nick Carter.

This noted "still trailer," who followed a track without a sound, immediately swung away from the river, nose to ground. Mullikin and the father of the child, with a lantern, ran behind the tugging dog. On the other side of a hill, he turned toward a waste patch. At this moment, both men tripped over a root and crashed to the ground, breaking the lantern. They were left in pitch darkness, while the dog rushed ahead.

Striking matches, they pushed slowly through bushes and briars. Finally, they heard a cooing gurgle ahead. It was the baby, her dress held fast in a tangle of brambles. One of her arms was around Nick Carter's neck and the dog was licking her face, doing his best to comfort her.

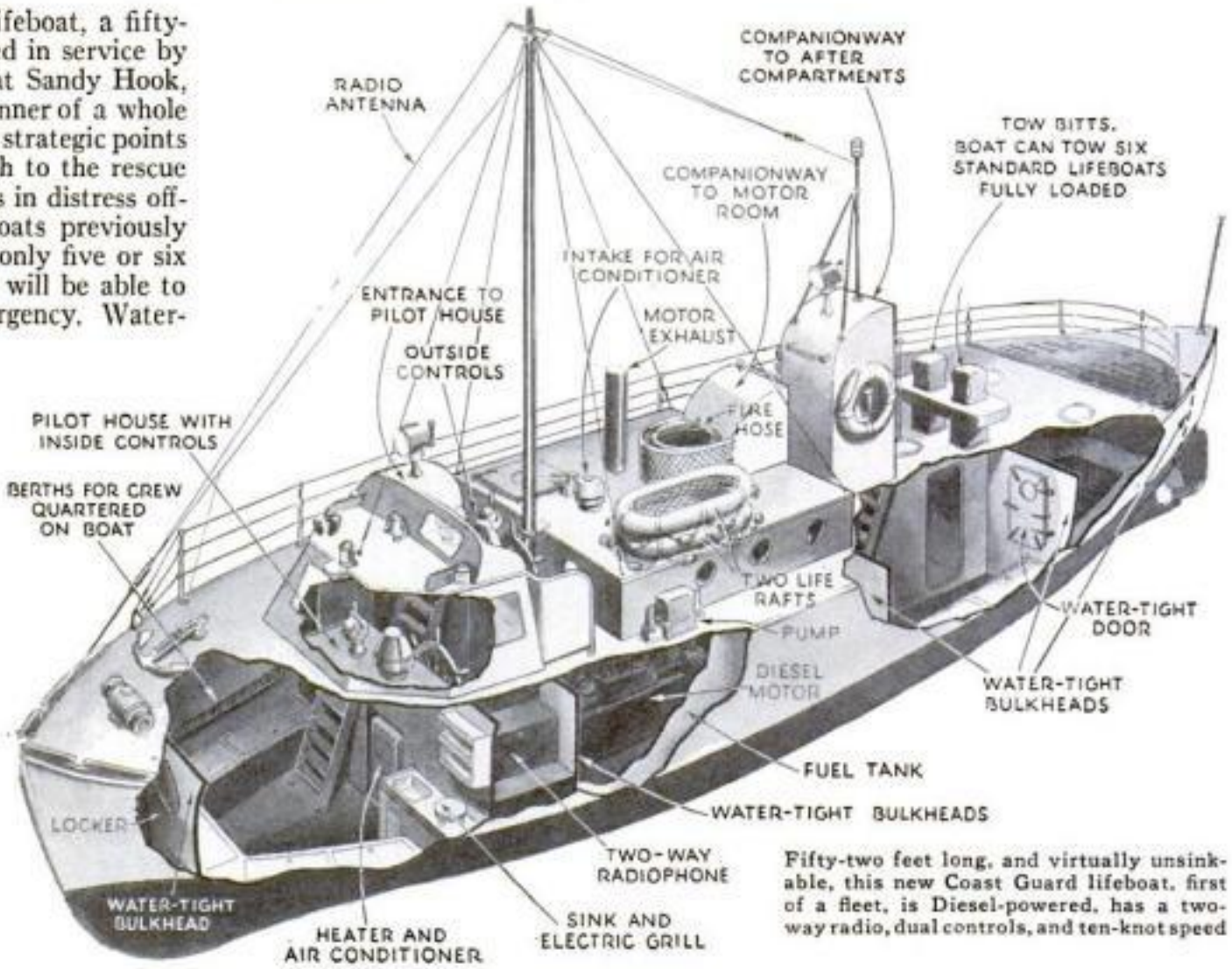
"Uncle Tom's Cabin" is probably most to blame for the popular misconception of the nature of *(Continued on page 100)*

In training bloodhound puppies, boys rub liver on their hands, as shown in oval. One boy has the liver, and both hold their hands behind their backs. The puppy is allowed to smell clothing belonging to the boy who has the meat, and if he picks the right one he is given the reward

At the left is a close-up of Toughey, one of Whitney's famous trailers, who has figured in many a sensational chase. The picture above shows the loose skin of a bloodhound puppy, a characteristic trait

Coast Guard Gets Big Rescue Boat

CALLED the world's largest lifeboat, a fifty-two-foot craft recently placed in service by the United States Coast Guard at Sandy Hook, N. J., is expected to be the forerunner of a whole fleet of similar craft. Stationed at strategic points along the coastline, they will dash to the rescue of passengers and crews of vessels in distress offshore. In contrast to smaller boats previously used, which could accommodate only five or six survivors at a trip, the new type will be able to take aboard 100 persons in an emergency. Watertight bulkheads make the boat virtually unsinkable, even in case of collision with drifting wreckage. A 150-horsepower Diesel engine drives the craft at a speed of ten knots, and two-way radio equipment is provided, with a transmitting radius of about 150 miles. A crew of twelve handle the craft, which is controlled from an outside bridge in fair weather and from a pilot house, with duplicate controls, during a storm. The engine room, in which thirty persons can stand, is air-conditioned, as are other parts of the boat. The craft is also equipped with an automatic fire-extinguishing system. The boat is named *Invincible*.



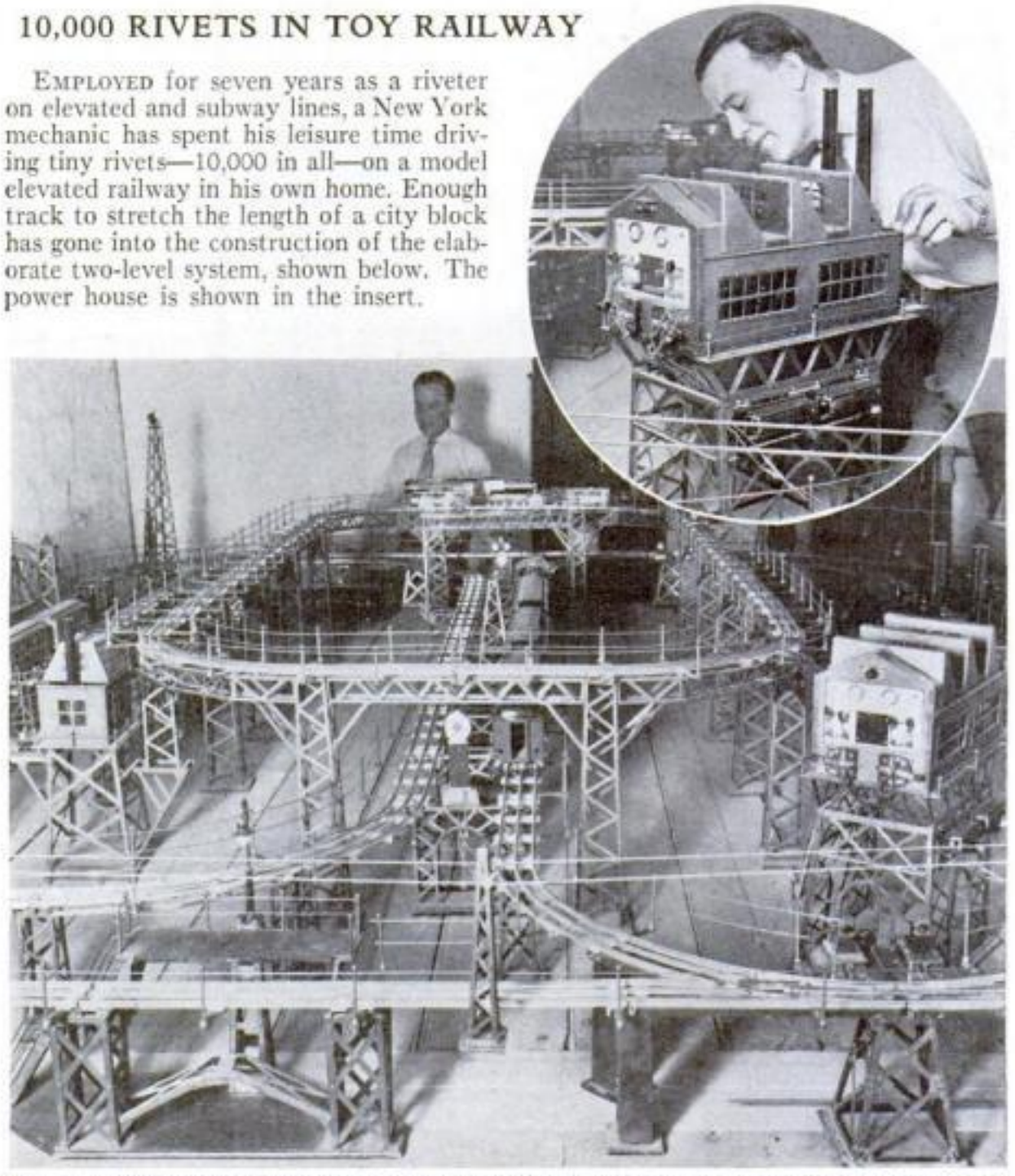
Fifty-two feet long, and virtually unsinkable, this new Coast Guard lifeboat, first of a fleet, is Diesel-powered, has a two-way radio, dual controls, and ten-knot speed

NEW WIRED-RADIO SET

WIRED radio—the transmission of programs to homes along electric light and power wires instead of over the ether—took another step forward the other day with the demonstration at Lakewood, N. J., of a receiver designed especially for the reception of the "broadcasts." Illustrated above, the receiver is housed in a cabinet about the size of a radiator enclosure, and hinged panels afford access to the control knobs. Wired radio has the advantage of freedom from static. Patrons may contract for any type of program desired.

10,000 RIVETS IN TOY RAILWAY

EMPLOYED for seven years as a riveter on elevated and subway lines, a New York mechanic has spent his leisure time driving tiny rivets—10,000 in all—on a model elevated railway in his own home. Enough track to stretch the length of a city block has gone into the construction of the elaborate two-level system, shown below. The power house is shown in the insert.



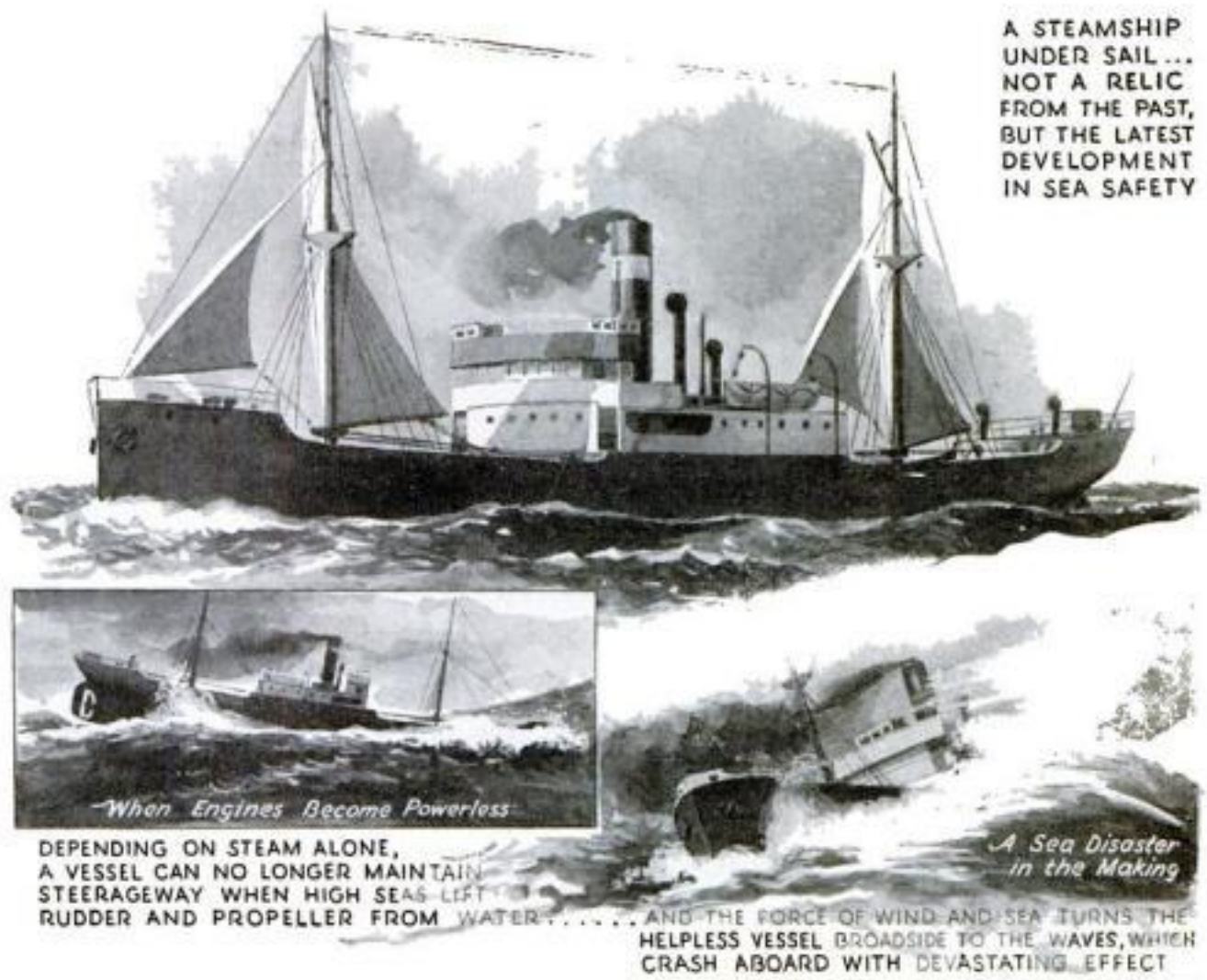
More than 250 feet of track were used in building this realistic model of a two-level railway system

Sails Aid Storm-Tossed Steamers

BY EQUIPPING three of his newest steamers with fore-and-aft sails, a prominent British shipowner is leading a return to sea styles of long ago. For sails, generally considered obsolete since the advent of steam propulsion, are making a come-back upon "tramps" and other small steamships. Countless marine disasters have taught the lesson that a vessel of this class cannot depend on steam alone for safety in a storm—especially when the ship is forced to heave to, or abandon its course and lie headed almost directly into the waves.

So long as a ship can maintain this position, it rises and falls as the waves roll under it, but no damage is done. In this situation, a steamship must keep its screws turning to maintain enough headway or steerageway for the rudder to take effect and hold the ship at the proper angle. But when mountainous seas lift the rudder and propeller clear of the water, the vessel no longer can be controlled, and lies at the mercy of the storm. Swept into the trough of the sea, it is battered by waves crashing over it broadside. Serious damage, or even the loss of the ship, may result.

All this is changed when the ship is fitted with sails. It is a simple matter to adjust sails so that the lateral pressure of the wind holds a ship at the correct angle after heaving to, without recourse to rudder or propeller. Even before it becomes necessary to heave to, the use of auxiliary sail on a steam vessel relieves the strain on the rudder and lessens the peril of broken steering gear. It also reduces dangerous rolling. For these reasons Sir Arthur Rostron, former commodore of the Cunard Line, recently advocated the use of auxiliary sails on all steam vessels up to 4,000 tons. Edmund Watts, British shipowner, promptly adopted the suggestion for his newest craft.



DEPENDING ON STEAM ALONE, A VESSEL CAN NO LONGER MAINTAIN STEERAGEWAY WHEN HIGH SEAS LIFT RUDDER AND PROPELLER FROM WATER . . . . . AND THE FORCE OF WIND AND SEA TURNS THE HELPLESS VESSEL BROADSIDE TO THE WAVES, WHICH CRASH ABOARD WITH DEVASTATING EFFECT

Drawing shows how sails safeguard small steamers

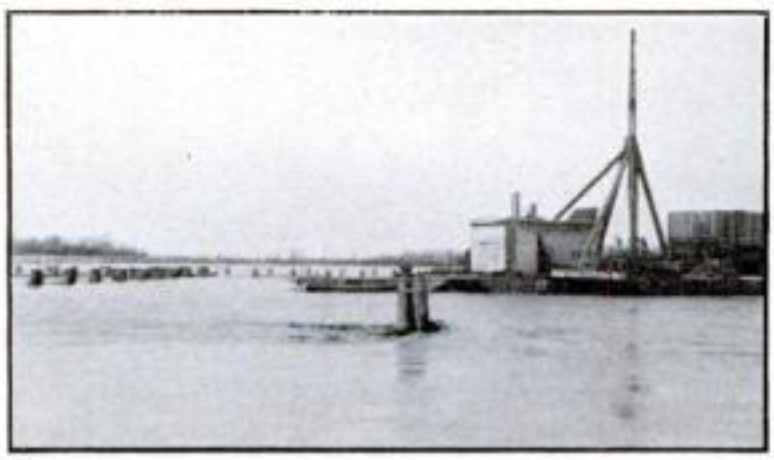
THIS TIME THE RIVER IS PUT UNDER THE BRIDGE

BUILDING a bridge on dry land, and then putting a river under it, was an unusual engineering feat recently begun at South Omaha, Neb. When the government undertook to make the upper part of the Missouri River navigable, engineers decided to force the river back into an old channel that it had deserted some years before. It was also decided to erect a bridge at this point. Nearly finished at this writing, the bridge stands on dry ground.

This is the bridge. It spans a dry channel into which the Missouri River will be turned. Then the unfinished approach will be completed

•

And this is the river in its present channel, which will be blocked by dikes to force the stream under the bridge

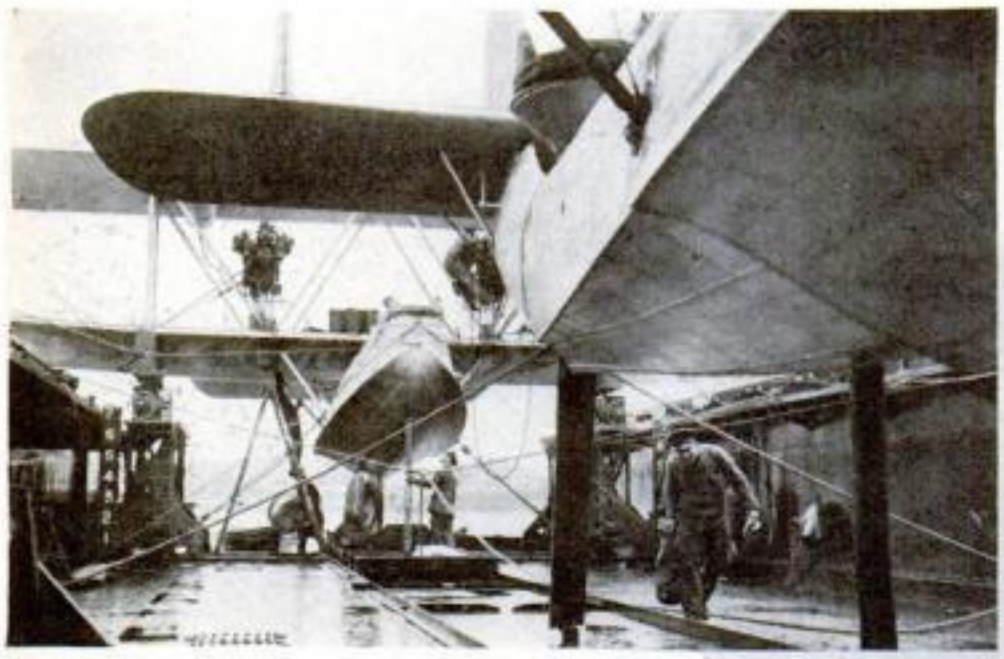


Patient's feet subjected to low air pressure in glass boots

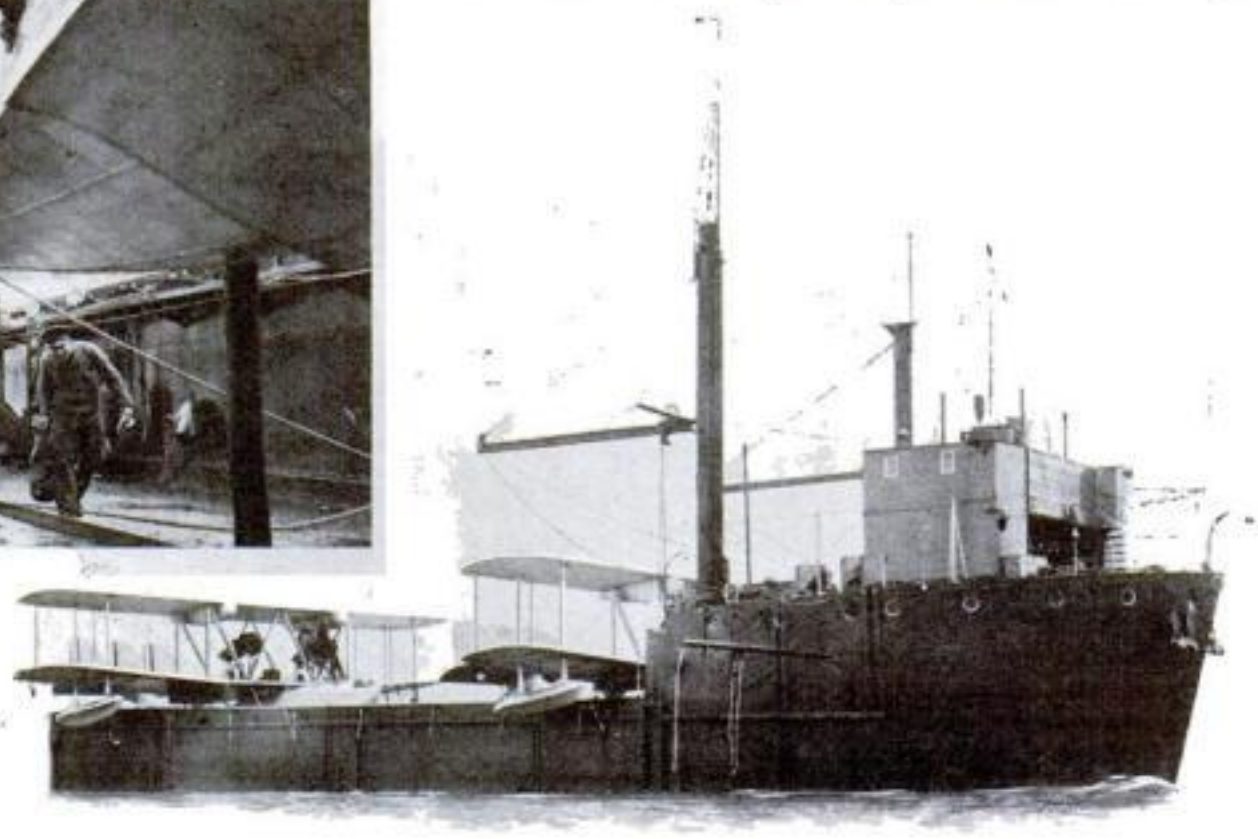
GLASS BOOTS NEW MEDICAL AID

HIGH-ALTITUDE conditions, beneficial to sufferers from arteriosclerosis, or hardening of the arteries, are reproduced synthetically in a New York hospital where one of the latest types of medical apparatus has just been installed. The device consists of a pair of "glass boots" in which the patient's feet and legs are encased. When a vacuum pump is set in operation, the atmospheric pressure inside the boots may be reduced to a degree comparable with that at any given elevation above sea level, and this lessening of external pressure permits improved circulation in the affected limbs. The photograph above shows a patient receiving the treatment while an attendant regulates the pressure.

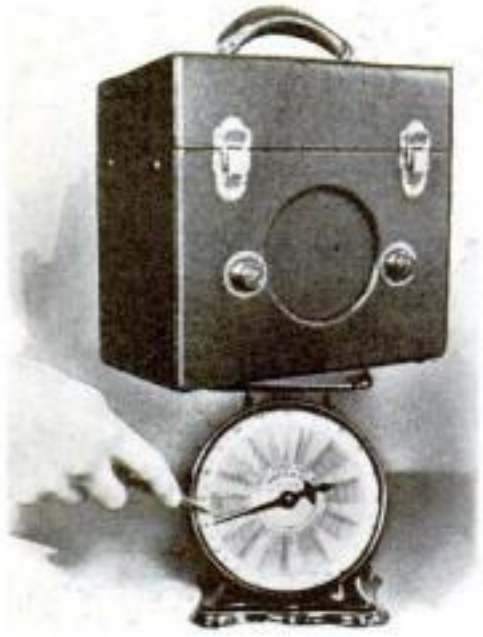
Floating Dry Dock Serves Seaplanes



Below, remarkable floating dry dock for seaplanes, which submerges to take aircraft aboard. Left, two seaplanes blocked up on the vessel's deck for repairs to pontoons and undercarriages



A 1,000-TON floating dry dock for seaplanes is a recent innovation at the base at Pembroke, England, where no "slipway" is available to haul the aircraft from the water when repairs are required. When the floating structure is submerged, an operation requiring twenty minutes, it can take aboard seaplanes of any draft up to seven feet. With buoyancy restored, the dock raises a plane high and dry so that the pontoons and other parts of the undercarriage are readily accessible to workmen for any repairs that may be necessary. A fully equipped workshop occupies the space below decks, together with accommodations for the crew of nineteen. The illustrations above show a pair of seaplanes blocked up for overhauling, and a general view of the dry dock as it appears in service. Constructed on the lines of a ship, the unusual dry dock can be moved from place to place to meet demands for its services.



COMPACT RADIO-PHONOGRAPH

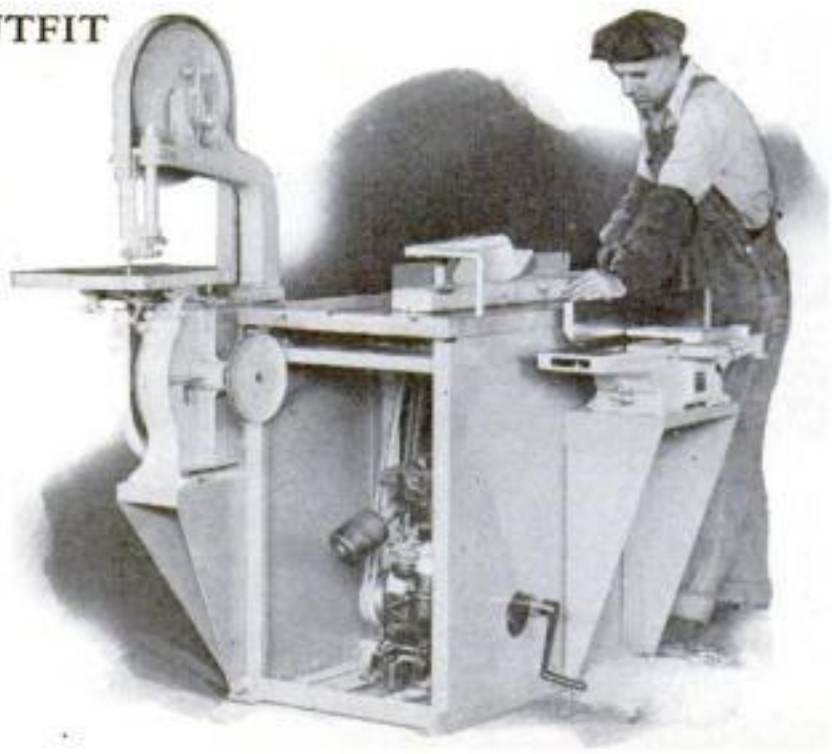
RADIO and phonograph are combined in a compact portable set which weighs less than fourteen pounds. A tiny electric motor rotates the phonograph turntable. The radio receiver, used both for picking up broadcasts and for reproducing phonograph recordings, employs a five-tube superheterodyne circuit.

PREDICT HIGHER PLANE SPEED

SPEEDS of 500 miles an hour or more for commercial airplanes in the near future are forecast by chemists as a result of the development of new types of gasoline, already under test, which are expected to provide an unprecedented output of power.

COMPLETE SAW OUTFIT IS EASILY MOVED

MOUNTED on skids, a new portable saw ouñt for home mechanics, carpenters, and contractors, shown at right, is easily transported from one job to another. A gasoline motor makes the device independent of electrical supply. It comprises a large table with a circular saw, and side benches with a band saw and a jointer, while attachments for boring, routing, and other purposes may be added as desired. As many as four men may use the unit at one time, according to the maker.



SEALS TRANSPARENT BAGS

HOME candy makers and others venturing into small-scale commercial enterprises may now put up their products in containers of professional appearance, with the introduction of a machine for sealing small objects in bags of glassine or cellulose-tissue type. Using no adhesive, the device employs heat alone to stick together the opening of each bag. A foot pedal clamps together the jaws, sealing and crimping the edges of the bag in a single foolproof operation.

Electric Organs Marketed

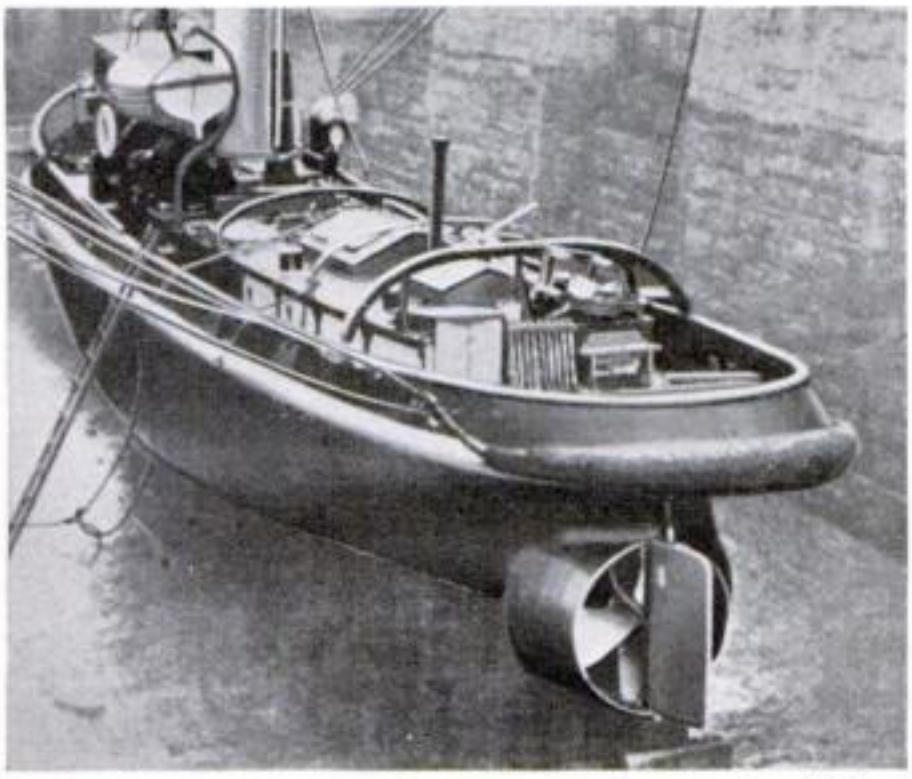
Keyboard of commercial electric organ, with draw bars by means of which overtones may be added for special effects

This compact home instrument produces electrically all the tones of a fine pipe organ and many new ones as well. Below is a rear view of the power cabinet showing the electrical apparatus

ORGANS that produce their tones electrically, long the subject of intensive laboratory experiment, are now available to the public. Compact and no more expensive than fine pianos, they provide all the effects of pipe organs and many new ones as well. A model just placed on the market, for home use, employs a console that takes up less space than an upright piano. A small auxiliary power cabinet contains two loudspeakers that render audible the tones generated by mechanism within the console. The artificial sounds are produced by rotating ninety-one thin, many-sided plates or "tone wheels," one for each pitch, before electromagnets, and amplifying the electrical disturbances produced. Small draw bars on the console keyboard may be pre-set to mix overtones with each note that is struck, in any desired proportion, and enable the timbre of flute, diapason, strings, or reeds to be selected at will. Other combinations yield synthetic tones, of surpassing beauty, that correspond to no known musical instrument. A lifetime would be too short to experiment with all the 253,000,000 possible effects, which are said to cover the entire range of musical tone color.

NOZZLE GIVES PROPELLER MORE POWER

BY ENCLOSING a ship's propeller in a ring or nozzle, engineers have found it possible to improve the efficiency of high-speed screws used in towboats and similar craft by from thirty to fifty percent. The accessory eliminates much of the power waste from slippage, by giving the blades a better "bite" on the water. Towboats on the rivers Elbe and Rhine in Germany have been the first to try the new nozzle.



Towboat equipped with propeller ring which increases its efficiency

NECKTIES OF WOOD

CARVING "neckties" from wood is the hobby of a city park supervisor of Akron, Ohio. Shaped, stained, fitted with elastic bands, and worn with a regulation woodsman's uniform, they preserve a neat appearance despite wind and weather.

B. F. Stout wearing one of his wooden neckties. At right, a half-finished tie being carved from a block

DEVICE SHOOTS MARBLES

EVEN the time-honored pastime of marble shooting has tempted the ingenuity of the inventor, and the mechanical marble shooter illustrated is the result. A plunger with a spring steel holder grips the marble, which is pulled back and released by a thumb button. According to the makers, the device adds zest to the game by combining speed with accuracy.

REALISTIC MODELS OF

Prehistoric Men

Made by New Casting Process

By ANDREW R. BOONE

The Heidelberg man, as reproduced with wood and wax by John M. Schliesser, a Los Angeles, Calif., taxidermist. At right, plastering a nail-studded form with clay as a framework for a figure

A mold made from the clay figure is filled with wax, as in the picture below. The molds are divided into three parts, for the head, trunk, and lower extremities

WORKING from measurements of bone fragments supplied by leading museums of America and Europe, John M. Schliesser of Los Angeles, Calif., has created specimens of five types of prehistoric men—the Trini or Java ape man, Heidelberg, Piltdown, Neanderthal, and Cro-magnon.

Schliesser studied human anatomy for three decades while practicing his profession of taxidermist. Recently, having obtained bone fragments and estimates of size and appearance of ancient men from museums, he undertook to reproduce them.

He started by cutting lengths of wood to represent principal body bones. These he bolted together in skeleton form. Over the skeletons he worked clay in accord with bone sizes, showing all muscles and details of the ancient human figure. Each head was made after he had measured a prehistoric skull with calipers to determine its size and contours.

After the figures were modeled in clay, Schliesser cast them in plaster forms, separating the molds into three parts, one for the lower body and limbs, another for upper body, and a third for the head. The bodies proper then were "poured" by filling the moulds with French beeswax, properly colored for the race to be represented. This wax, hardened by a secret process, will not melt at ordinary atmospheric temperatures.

After grafting the head into place with melted wax, Schliesser scraped and sandpapered the bodies to a satin finish. He imitated profuse growths of hair by inserting, singly and in groups of two to four, human hair into the bodies, on faces and heads. For this delicate process he employed two sewing needles from the heads of which the crowns had been broken, thus providing small two-tined forks. When finally the hair was smoothed and faces tinted, the figures were complete.

The five figures, representing races which once existed in various parts of the world, reveal the beginnings of intelligence. The ape man had no implements. The Heidelberg man learned to wear skins. Piltdown not only made clothing of skins, but slept on beds of skins. Neanderthal used implements made from rocks and lived in caves guarded by revolving rock doors. The Cro-magnon man possessed weapons of greater killing power and wore wrap-around shoes.

Schliesser's shop is a veritable wonderland filled with the stuffed and mounted figures of birds, animals, and reptiles. One of his specimens is a stuffed embryo whale.

A view of the completed Java ape man, with Schliesser adding finishing touches to the hair. Note the replicas of rock and wooden club. The ape man, most primitive of the five types reproduced, had no implements or tools

This picture shows the process of inserting human hair into the wax figures with a tool consisting of two sewing needles in a wooden handle

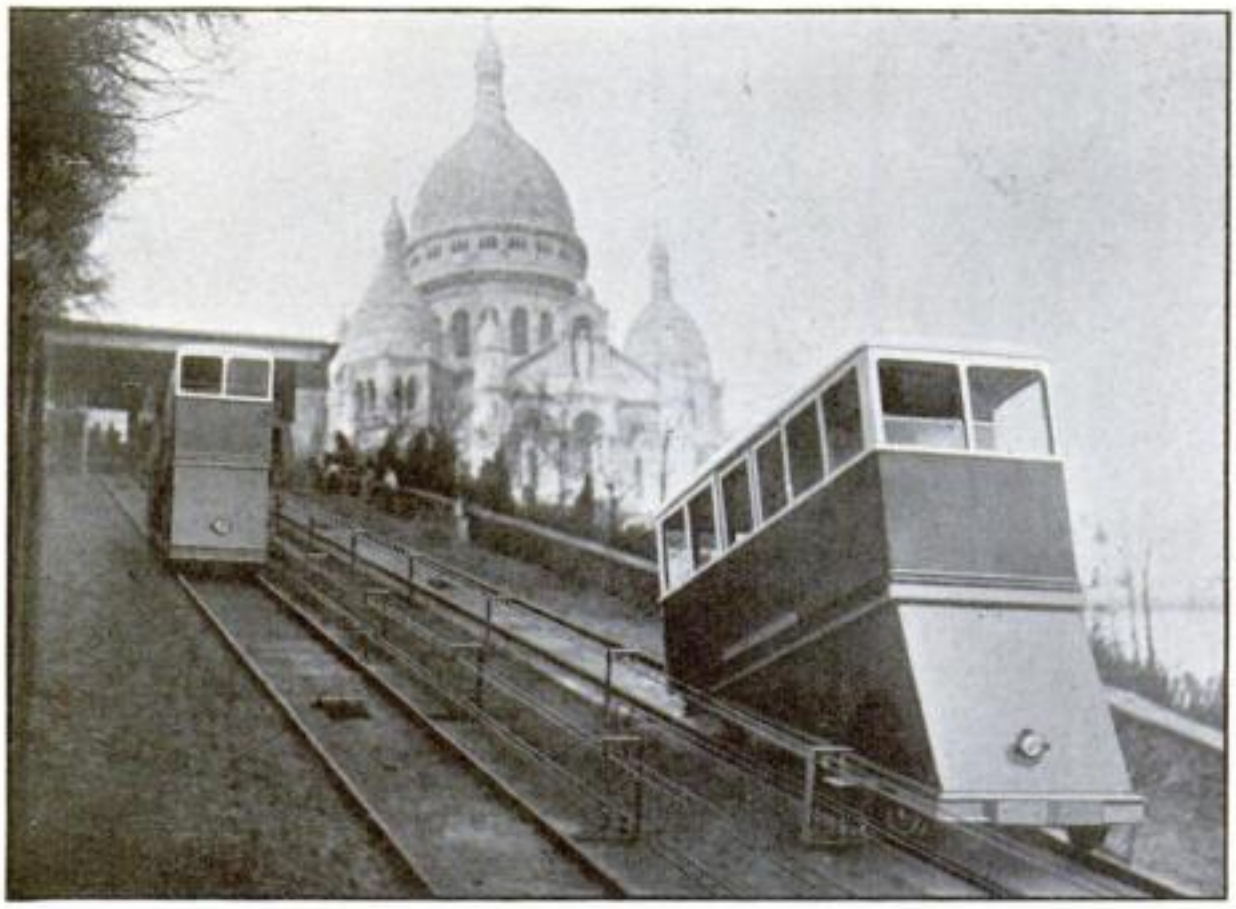
The Piltdown and Neanderthal men receive a final treatment. The workman on the left is smoothing an artificial thumbnail, while the man at the right scrapes Neanderthal's rock base. The weapons are accurate reproductions

By measuring the actual skull of a prehistoric man, Schliesser gets the dimensions for one of his figures. Skulls, bone fragments, and estimates of size were obtained from museums

The Neanderthal man gets a facial. The wax head is being scraped before it is set on the figure. The French beeswax base is colored to suit the racial complexion, and water colors are added

A bone from the right forearm of a primitive man, in contrast with the arm of a modern man. Note its great length and size. Schliesser's reproductions are based on studies of anatomy made during his thirty years of experience as a skilled taxidermist

HUMPBACKED CARS USED ON INCLINE

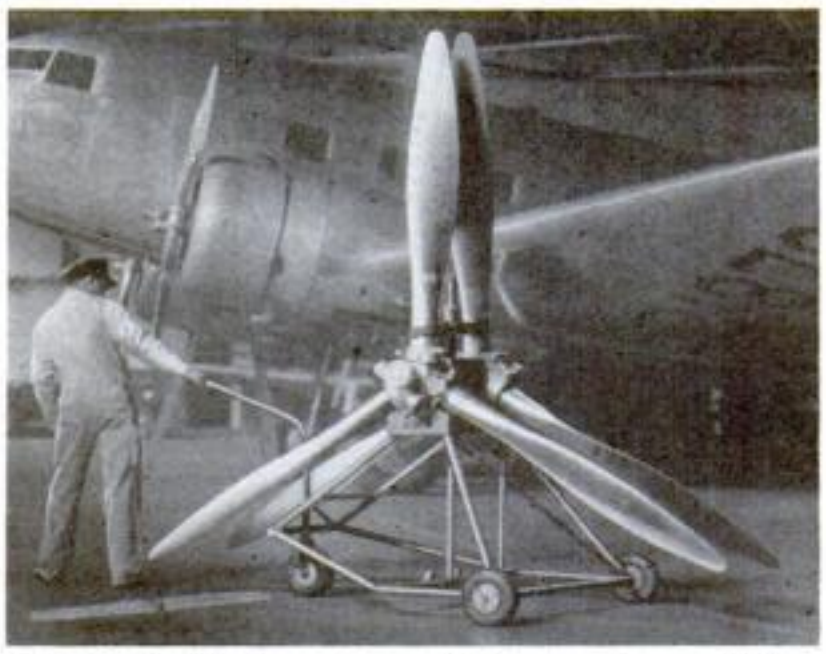


Passengers are not jostled by hill climbing in these odd cars, since the seats are always level

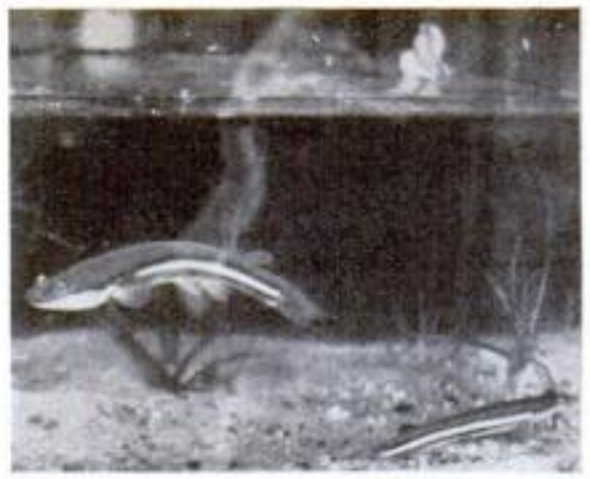
HUMPBACKED trolleys now carry tourists up and down the hill on which the Montmarte section of Paris, France, is situated. Because of the extreme steepness of the grade, the cars rest upon inclined undercarriages in order to keep the seats level. The new equipment marks the resumption of service on the short railroad, which for some time was discontinued.

DOLLY CARRIES PROPELLERS

TO CARRY one of the most awkward loads imaginable—a pair of three-bladed airplane propellers weighing 700 pounds—the dolly illustrated at right has been devised by mechanics of a transcontinental airline. When a plane rolls in at the maintenance base for overhaul, the rubber-tired cart enables one man to haul the big "props" from the air liner to the shops and back again, without danger of damage. Formerly three men were needed.



Mechanic hauling heavy transport-plane propellers on dolly



Odd Mexican fish which have two pairs of eyes

Diagram shows how both pairs of eyes use the same lenses

FOUR-EYED FISH SEE ABOVE AND BELOW WATER

A PAIR of four-eyed fish from Southern Mexico, first of their kind ever brought to this country, recently went on exhibition at the American Museum of Natural History in New York City. Swimming along the surface of the water, the fish use one pair of their eyes to watch what is going on above, while the other pair is directed in the water beneath them. The air-and water-eyes have separate retinas but use the same lenses, a different part of the same bulging lens serving for each, as shown in the diagram above.

SWISS POWER PLANT HAS HIGHEST MAN-MADE FALL

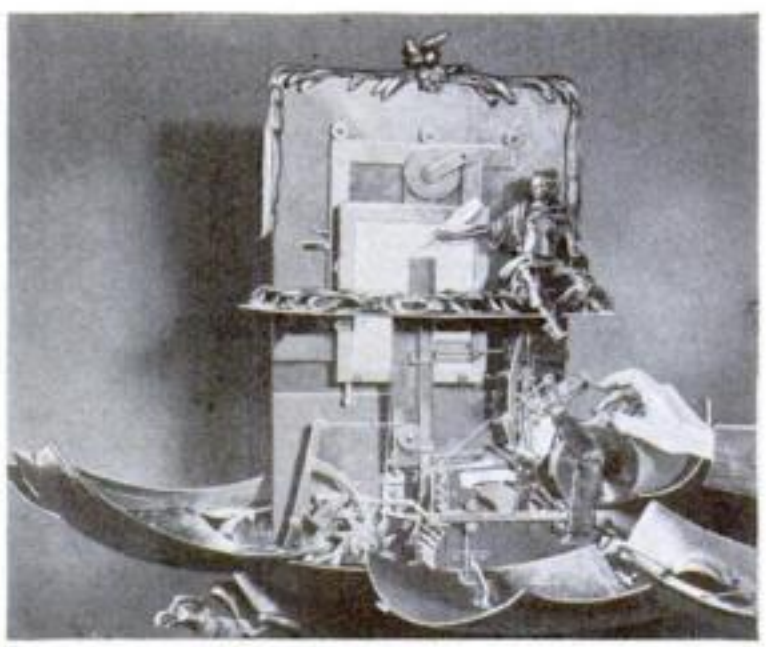
AN ARTIFICIAL waterfall more than a mile high drives turbines in a new Swiss hydroelectric plant. Through rugged metal conduits, the water drops a distance of 5,741 feet, and is traveling at a speed of seventy miles an hour by the time it hits the turbine blades. This is said to be the highest man-made waterfall in the world although the volume of water is small as compared with other hydroelectric plants.

TINY STATUETTE HOLDS PEN IN ANCIENT WRITING MACHINE

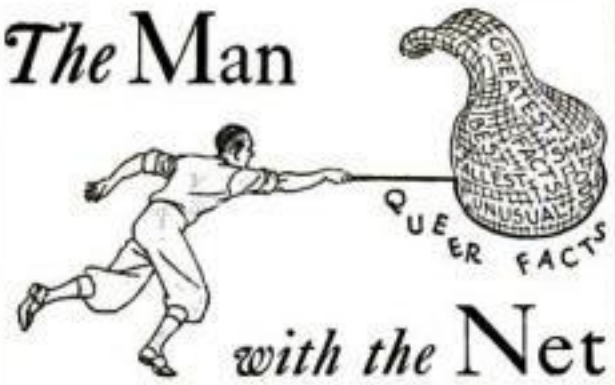
A STRANGE machine believed to be the granddaddy of the modern typewriter, built by an ingenious craftsman in 1760, has just been unearthed and displayed in Vienna, Austria. When its levers were manipulated, a quill pen in the hand of an animated figure wrote script letters upon paper. The operating train of mechanism, of staggering complexity, was housed in folding segments that closed to form an ornamental globe. The figure holding the pen is believed to have been intended as a likeness of the reigning Empress.

TEST ROADS IN COLORS

COLORED concrete, said to reduce the glare of sunlight during the day and the reflected dazzle of headlights at night, is being tried out on highways in England.



Strange writing machine, showing statuette, pen, and paper at top, and left, the complicated parts assembled

The Man  *with the* Net

SOME CATERPILLARS *increase in size 10,000 times in thirty days.*

NATURE *takes 400 years to produce an inch of fertile topsoil.*

KITE FLYING *has been outlawed in Shanghai, China, because of the danger to airplane pilots.*

COWS *have better memories than horses.*

THIRTEEN PASSENGERS *can ride in a two-and-a-half-ton soaring plane now under construction in Russia.*

PREHISTORIC LIZARD *tracks, 225,000,000 years old, have been found in the heart of the business district of Lincoln, Neb.*

PAPER CLIPS *were used by pigeons in New York City to build a nest on a window ledge.*

SUNLIGHT *strikes the Rock of Remembrance in the new War Memorial at Melbourne, Australia, only once a year, at 11 A.M., November 11, the exact moment the armistice, ending the World War, went into effect.*

APPLE TREES *are attacked by 176 kinds of insect pests. Five hundred kinds attack oaks.*

WALRUSES *use their tusks to dig up clams from the sea bottom.*

BIRDS *have three eyelids.*

VISITORS *at the 1934 Chicago World's Fair consumed 2,000,000 hot dogs, 4,600,000 hamburger sandwiches and 8,000,000 quarts of coffee.*

WHITE CANES *for blind pedestrians are required by an ordinance proposed in East Orange, N. J.*

WOODEN SHOES *are manufactured and sold in the United States at the rate of approximately 1,000,000 pairs a year.*

Reflector button in recess in curb of highway

REFLECTORS IN CURBS MARK SIDES OF HIGHWAY

Reflecting buttons set into the curbs of a highway are being tested in England as a protection for motorists driving on dark or foggy nights. Colored red and white, the reflectors gleam in the rays of an approaching automobile's headlamps, clearly showing the boundaries of the paved surface and preventing a driver from running off the road. Set in recesses, the reflectors face an approaching car.

CUTS BRAIN NERVES TO CURE STRANGE DISEASE

By cutting half way through certain nerves in the brain, Dr. Walter E. Dandy, noted Baltimore, Md., surgeon, has been able to cure Meniere's disease, a puzzling affliction which produces severe spells of dizziness.

SURGEONS SEEK TO SAVE FAMOUS VINE

Tree surgery was applied to a grape vine for the first time when experts treated and filled the cavities of the famous old Ramona Vine, at San Gabriel, Calif., in an effort to save it from destruction from the combined effects of dead wood and termite attacks. The 164-year-old vine, with a central stem that rivals a tree trunk in size, is supported by an arbor covering half an acre, and attracts thousands of tourists every year.

Tree surgeons at work on the Ramona grape vine at San Gabriel, Calif.

Editing home movies with aid of a new device

HELPS TO EDIT HOME MOVIES

To aid in editing home movies, a new device winds the film slowly over a brilliantly illuminated aperture. Through a powerful magnifier, the film images are seen greatly enlarged. Small gummed stickers are attached to mark the end of each scene, making cutting and splicing easy when the scenes have been listed. The device has a built-in splicer, a film-cleaning attachment, and two rewind speeds. It handles film of either eight- or sixteen-millimeter size.

WATCH ON IGNITION KEY

A midget watch serves as a handle for a novel ignition key designed by a Westwood, N. J., inventor. Handy for auto tourists, it may be removed and carried in the pocket or stood on a hotel dresser, while on the road it serves as an automobile clock as shown in the illustration, helping its owner to keep business engagements.

ELECTRIFIED MEGAPHONE HELPS TO TRAIN CREWS

WHISPERS are transformed into shouts by an electric megaphone invented in England. When the user speaks into the mouthpiece, his voice, amplified many times by electricity, comes booming from the flared end. The device has been adopted by the rowing coach of Cambridge University to make his instructions carry across the water to the crews of racing shells during the period of training that precedes a regatta.

SPOON HOLDS MEDICINE WITHOUT SPILLING

POURING out a teaspoonful of medicine is made less of a juggling feat by a new spoon with a measuring cup built into its bowl. When the spoon is held vertically, it may be filled and carried across a room, if need be, without danger of spilling. Held horizontally, the spoon may be used in the ordinary way. The convenient utensil is especially for use in sick room or hospital, where it frequently is necessary to carry a measured amount.

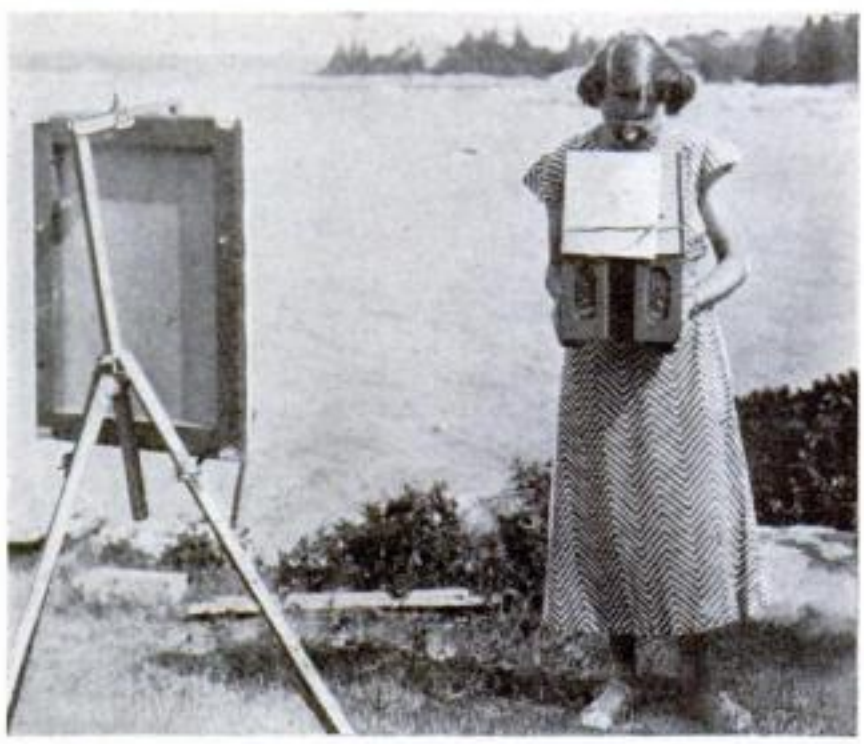
NAIL HAS TWO HEADS

A NAIL with two heads has just been introduced for assembling forms, staging, and all types of temporary construction. Its square lower head, one half inch square, permits the nail to be driven home with force enough to hold the forms tightly. An upper head remains projecting, affording a convenient grip to pull out the nail when it has served its purpose and preventing damage to the lumber in the process. Both can be used again.

Hammerclaw can always grip head of this nail

VIEW BOXES REVEAL ARTISTS' ERRORS

The wall-eyed camera which compares a picture with its subject



For comparison, artist points one box at scene, the other at canvas

A "CAMERA" for artists, devised by a Boothbay Harbor, Me., instructor, aids students to grasp the fundamental principles of color and perspective. The device comprises a pair of boxes hinged together, each one having a lens and mirror so arranged as to throw an upright image upon a translucent screen. One of the lenses is trained upon the scene being painted, and the other upon the canvas on which the novice is working, so that the student sees the landscape and the reproduction of it side by side, and can rectify mistakes.

How new steel-cable bicycle lock is fastened

BICYCLE CARRIES LOCK IN ITS HANDLEBAR

A TREE, a lamp post, or a telephone pole makes an effective hitching post for a bicycle equipped with an ingenious new lock. When a flexible steel cable is withdrawn from its place in the handlebar, run around any fixed object, and plugged into a socket on the frame, the bike is there to stay until the owner returns with his key. The device is calculated to balk even a thief enterprising enough to carry away a bicycle with a padlocked wheel.

ROBOT TELEPHONES POLICE

A ROBOT that silently lifts the receiver and telephones the police if a burglar enters the house has been invented by a British experimenter. Attached to an ordinary telephone, the automatic apparatus is contained in a small box which can be secreted in an inconspicuous place in the house. As the burglar opens a window or door, he trips the alarm, lifting the telephone receiver and setting a small phonograph record turning.

OPEN-DECK FERRY IS UNUSUALLY ROOMY

"PUMPKIN-SEED" ferryboats, providing virtually unobstructed deck space for transporting automobiles, are a recent invention. Because of the compact engine-room arrangements of the Diesel-driven craft, each is able to accommodate thirty-four cars. Two of the new 125-foot boats have just been placed in service to ferry vehicles across the Panama Canal, as a link in a main highway.

Suggesting the seed of a pumpkin, this ferry has a wide, roomy deck

CATTLE FODDER MADE FROM WOOD PULP

SYNTHETIC food made from sawdust soon may enter the realm of commerce. Experimenters have already succeeded in transforming small batches of wood pulp, by chemical treatments, into cattle fodder. Now Dr. Friedrich Bergius, celebrated German chemist, is developing the process on a large scale at Mannheim, Germany. Scrap logs are pulverized and "digested" in huge tanks where the non-edible cellulose of the wood is converted into edible carbohydrates. A mealy, nutritive fodder for livestock is the present product, with human food looming as a distinct possibility.

Scenes in a German plant where wood is transformed into food for cattle. Upper left, the finished product; upper right, emptying one of the "digesting" tanks; left, the battery of tanks; above, pulverizing logs, the raw material

The frame of this portable dressing room is actuated by a spring which raises the fabric envelope to afford complete privacy anywhere

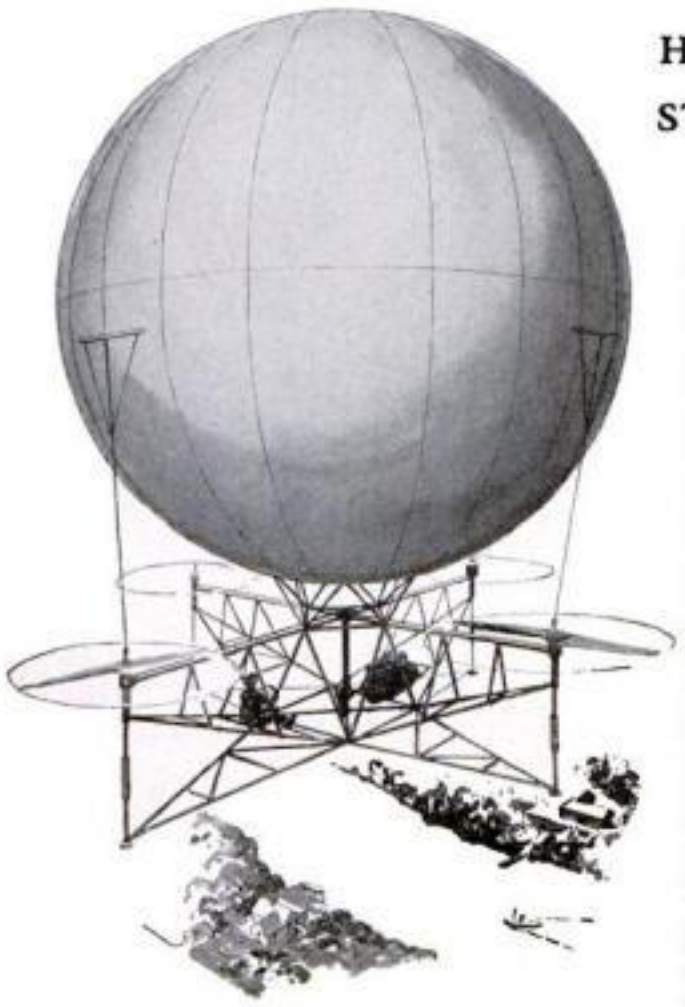
FOLDING DRESSING ROOM

SET UP anywhere, a portable dressing booth for bathers offers complete privacy when extended, and folds to small space for carrying. The "jack-in-the-box" frame of metal is actuated by springs that raise the fabric envelope to full six-foot height when hooks holding it in collapsed position are released.

PIANO IS AN ORCHESTRA

PRODUCING the effect of a piano accompanied by violins and cellos, a novel instrument designed by a Tulsa, Okla., inventor employs a motor-driven, rosin-covered roller as a bow. Taut cords, drawn against the roller, communicate their vibrations to the piano strings.

A novel piano which plays its own violin accompaniment. Violin-tone mechanism is seen in circle



HOLLOW GLOBE STABILIZES STRANGE NEW HELICOPTER

LIKE an oversize basketball in a monster gymnasium, a globular flying machine recently bobbed about in the great dirigible hangar at Orly, France, under the control of Etienne Oehmichen, noted French inventor. One vertical ascent took it to a height of fifty feet, where it hovered motionless, its four propellers buzzing, for a full minute. The odd craft represents the latest of Oehmichen's many attempts to create a successful helicopter, or heavier-than-air machine capable of rising straight up. The purpose of the seventeen-foot globe is not to lighten the craft but to give it stability—the great problem of helicopter builders. This sphere actually adds to the weight of the machine, since it is filled only with air. However, the globe resists any sudden overturning tendency, and points the way, Oehmichen believes, to a practical helicopter design. The illustration shows how the odd craft would look in actual flight.

STEAM WIND VANE AIDS NAVY FLIERS

A JET of steam, released at the bow of the British airplane carrier *Eagle*, shows pilots when the wind direction is right for a take-off. Unlike the trailing wind cones seen at airports, the white plume of vapor presents no physical obstruction—an important advantage where clear deck space is at a premium. The photograph shows a plane leaving the carrier safely as the latter heads almost directly into the wind. A cross wind would make the take-off hazardous.

PHONOGRAPH NEEDLES IN NON-SPILL PACK

REPLACING a used phonograph needle is made easy and convenient by a new dispenser that ejects one at a time. The handy device, manipulated as shown in the photograph, ends the nuisance of spilled needles and pricked fingers, familiar to users of the standard paper packages. With the new device, the desired needle simply drops into the palm of the hand. It can then be picked up easily between index finger and thumb and inserted in its proper place in the machine.

Shaking package ejects needles singly, as shown

WASPS FLOAT PREY HOME

HUNTING wasps that paralyze spiders and then float them downstream to their nests were recently observed in action by a Missouri entomologist. The wasps dragged their prey to the stream and into the water, letting the spiders float on the surface while they flew along towing them in the direction of their nests. In this way, they reduced the labor of getting the spiders home. This phenomenon seldom has been observed scientifically.

ROSES HAVE TWELVE-FOOT STEMS

ROSE BLOSSOMS with twelve-foot stems were a novelty exhibited by a Council Bluffs, Iowa, florist at a recent flower show. By destroying thousands of other roses, he produced fifty of these rivals to Jack's famous beanstalk. Starting a year in advance, he pinched off each shoot upon a plant that threatened to flower, forcing each bush to send its stalk higher and higher. Eventually wire braces were needed. When they finally hit the ceiling, the florist let them bloom. The photograph shows him with one of his remarkable creations.

These new masks give college boxers complete facial protection

WEIRD MASKS PROTECT COLLEGE BOXERS' FACES

BOXERS with visages like legendary goblins now trade punches at the College of the City of New York, wearing odd masks designed for intercollegiate bouts by Dr. Canute Hansen, director of physical education. The devices, he reports, effectively prevent physical injuries and disfigurements such as have caused boxing to be permanently banned at many educational institutions. Two of the unusual protectors are shown at the left.

"GRAVEYARD" TESTS WOOD DURABILITY

Rows of wooden posts, implanted like cemetery markers in a field adjoining the Forest Products Research Laboratory near London, England, are showing scientists how to erect buildings that will withstand weather extremes and the attacks of insect pests. Prolonged exposure of carefully labeled samples, in the "graveyard," permits the experimenters to determine the relative durability of different kinds of wood by actual exposure.

Samples of wood under test for resistance to weather and vermin

BREAKS IN BRIDGE PERMIT EXPANSION

Tower leg of bridge, showing crack which permits structure to expand

FOLLOW the crack in the center of the tower leg supporting this section of the San Francisco-Oakland Bay Bridge, shown in the photograph, and you will find that it goes through the entire bridge structure, including the lower and top decks. The split is no accident or mistake of engineers, but is one of the carefully planned expansion joints that permit the steel framework of the massive structure to expand along its length on hot days and contract on cool ones. Sliding decking covers the gaps. If the joints were not provided, the steel members would inevitably buckle or tear apart under the terrific strains set up by any sudden changes in the temperature.

Compact pocket safety razor assembled for use

FOUNTAIN-PEN RAZOR FITS IN THE POCKET

A POCKET safety razor no bulkier than a fountain pen, which it closely resembles, has just been introduced. To open it for use, a cap at one end is unscrewed and the handle, with the crosshead clipped to it, withdrawn. The head is then screwed in place and the razor is ready for service.

NEW RING CUTS STRING

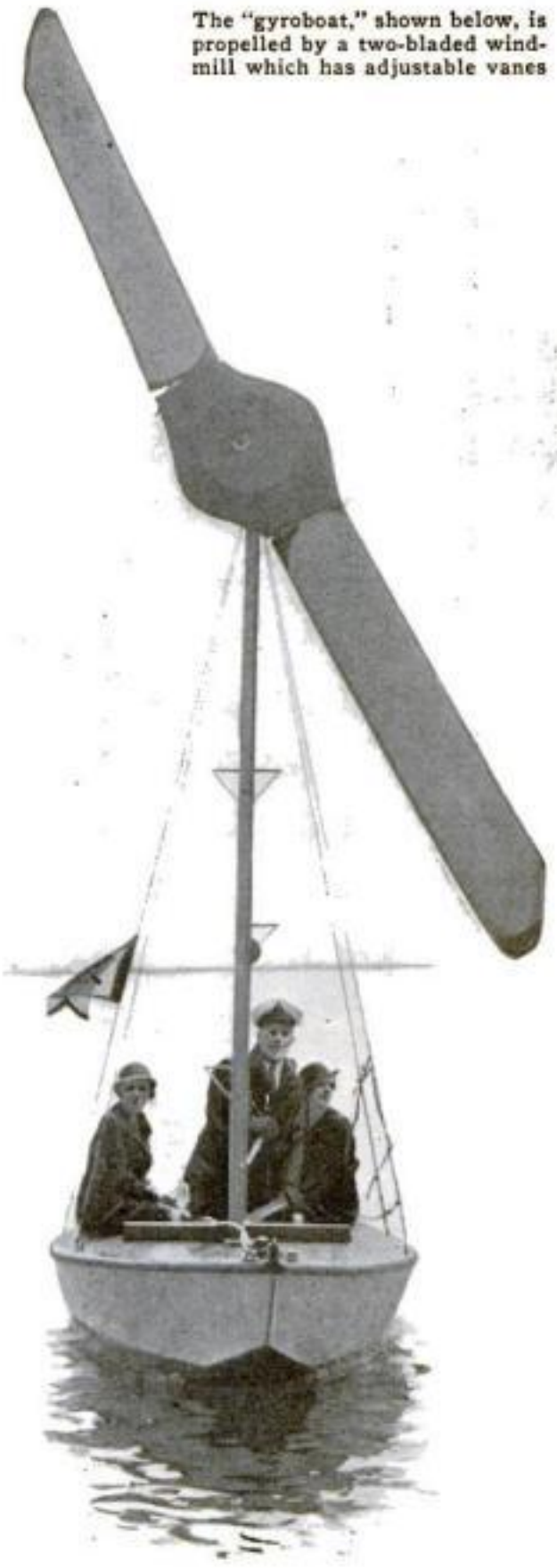
PROVIDED with a built-in string cutter, a new finger ring serves a useful as well as a decorative purpose. The sharp cutting edge lies recessed beneath the face of the ring, where it comes into instant play when a length of cord, twine, or thread is drawn taut in the slot.

ROBOT TELLS TRAVELERS WHEN NEXT TRAIN GOES

AN AUTOMATIC train information booth, recently installed at the Victoria Station in London, England, provides convenient aid for the bewildered traveler. When he punches a button corresponding to the station to which he wants to go, he receives a printed card showing at what time the next train leaves, and thus is spared the labor of puzzling over a complicated time-table.

Traveler presses button to get train information

The "gyroboat," shown below, is propelled by a two-bladed windmill which has adjustable vanes

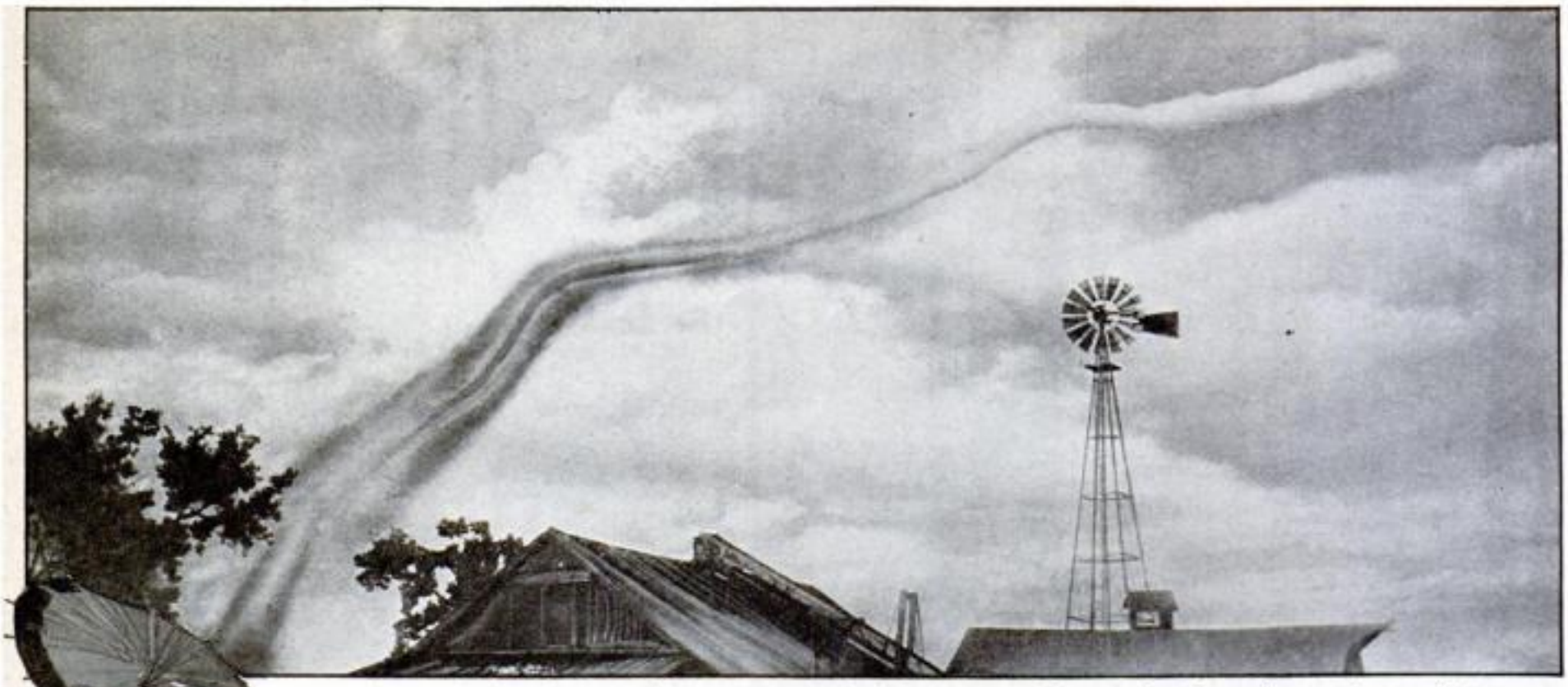


ODD WINDMILL BOAT RUNS ON AUTOGIRO PRINCIPLE

A TWO-BLADED windmill, with vanes that may be adjusted to take advantages of changes in the wind, drives a new type of marine vehicle known as a "gyroboat." Invented by E. Burke Wilford, aeronautical engineer of Merion, Pa., the craft is reported to have attained a speed of eight miles an hour. It is said to incorporate aerodynamic principles similar to those previously employed by the inventor in his "gyroplane," an airplane of the autogiro type with blades of adjustable pitch (P. S. M., Aug., '34, p. 47).

STUDIES FOSSILS WITH INFRA-RED RAYS

INVISIBLE light is helping a scientist at Glasgow University, Scotland, Dr. John Walton, study prehistoric leaves found in coal. Dr. Walton has discovered that infra-red rays, make the densest leaves transparent so that the fine detail of their inner structures can be photographed.



A tornado in action—a whirling vortex of wind that can snatch up a church steeple or a horse and buggy

A harvest of broken umbrellas gathered from a New York City sidewalk after a heavy rainstorm which was accompanied by high winds

Strange Pranks *of the* Wind

BLACK blizzards of dust recently swept across the Middle West. From the Rockies to the Mississippi, from upper Kansas to the Texas Panhandle, the scourge left its trail. In rolling clouds and suffocating billows, it blotted out the sun, paralyzed traffic, and buried fertile fields under a drifting blanket of dust.

When scattered showers cut through the haze, cowboys were driving herds from dust-choked ranges, farmers were digging out wagons and tractors, and statisticians were calculating that, in wide areas, crops would be cut to drought-time proportions.

In Kansas, alone, approximately 70,000,000 tons of dirt rode the winds from the western half of the state to eastern counties. Ninety-six miles of trucks, each hauling fifteen tons a day, it is estimated, would have to work for a solid year to return the soil transported by the breeze in less than a week. Dust damage in one Kansas town of 1,500 inhabitants was put at $10,800 or $7.20 for each person in the community.

A million-dollar Government war chest and 200,000 tractors, mobilized in Kansas, represent the initial move to fight the menace of wind-borne dust. In many areas, the fields will be "listed," or furrowed, every ten feet to form barricades and hold the drifting particles in check.

Recent droughts and the plowing up of western grass lands during the war-time wheat boom, are largely responsible for present dust storms. In line with the Government program of replanting these grass areas, the U. S. Department of Agriculture last year introduced from abroad nearly 1,800 varieties of plants and grasses valuable for checking soil erosion.

When the dust blizzards were at their height, strange things occurred. Static electricity, generated by the flying particles, charged barbed wire fences, stalled automobiles, and made men's and women's hair stand on end.

Near Hutchinson, Kans., a contractor had taken the job of removing 10,000 cubic yards of dirt in connection with a county road project. His men had hardly loosened the earth when the dust storms swirled over them. The next day, they returned to the job. All the dirt was gone.

This is a fair sample of what a tornado does to wooden buildings that get in its way. The scene is a plantation in Texas

Fantastic tricks of rapidly moving air currents, once ascribed to supernatural causes, present new problems to science in protecting human life and property

By Edwin Teale

Residents of a southwestern city don masks for protection against dust during a storm

The wind had carried it completely away!

Fantastic as that story sounds, it is almost commonplace beside other fact-tales of queer, unbelievable things carried off by the wind. At various times and in various parts of the country, minnows, turtles, tadpoles, gold dust, eggs, hay, mud, not to mention trees, houses, and even a horse and buggy, have ridden invisible air currents through the sky.

At Danville, Va., some years ago, seashells fell from the sky and rattled on the roofs of houses during a downpour of rain and hail. Yet, Danville is 200 miles from the coast. The shells and fragments had traveled through the air all that distance after being picked up by violent winds along the beach.

Even more amazing is an occurrence which took place at Bovina, Miss., about eight miles from Vicksburg, in 1894. During a hailstorm there, an ice-encased turtle plunged out of the clouds. It was eight inches long and six inches wide. Tossed up and down by the turbulent air currents, high above the ground, it had been turned into a living hailstone as layer after layer of ice formed over its shell.

While most of these bizarre riders of the wind appear during storms, one of the strangest of all rained out of a clear sky on Baton Rouge, La. Early one Friday morning in the spring of 1896, pedestrians on their way to work were bewildered at the sight of hundreds of dead birds showering down out of a clear sky. Their bodies thumped on the sidewalks, rebounded from the rooftops, literally cluttered up the pavements. Catbirds, woodpeckers, wild ducks,—they fell in such numbers that 200 were picked up on a single avenue.

Among the theories advanced to explain this astonishing "birdfall" the most plausible seems to be that the migrating flocks were caught by a storm which had raged along the coast the day before and had been carried high into the sky by a terrific updraft. Here, either the thin air or the intense cold killed them and later, as they fell, air currents carried them over Baton Rouge.

A Kansas farmer prepares to dig his tractor out of the piles of dust that wind has deposited around the machine

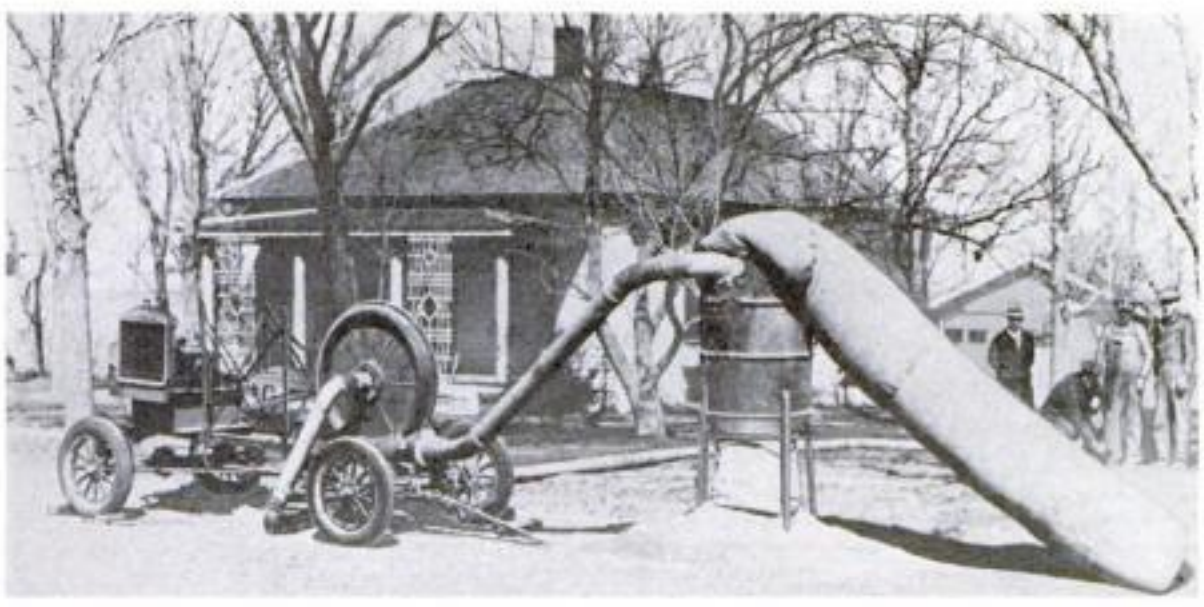
A freak of the wind—a small automobile under a tree which was dropped on it in a storm. The debris of a building is also part of the pile

Both gold and silver are numbered among the strange cargoes which have ridden air currents for long distances through the sky. Not long ago, dust storms in California deposited tons of dirt in the streets of Los Angeles. An assayer scooped up some and examined it. He found gold and silver dust which had come hundreds of miles from desert regions in the interior.

Mud storms are comparatively common. Many occurred in the Middle West this spring after the dust blizzards had filled the sky with particles of dirt. High above the ground, rain, combining with the dust, had formed the mud which fell in several communities.

In other cases, dust has colored raindrops and snowflakes, producing drifts of yellow or crimson snow and red rains which the superstitious people of the Middle Ages thought were rains of blood.

In England, several centuries ago, a whole countryside was terrified by a "rain of sulphur." Phosphorescent yellow particles drifted down through the air, glowing weirdly in the dark. They coated houses and cov- *(Continued on page 108)*

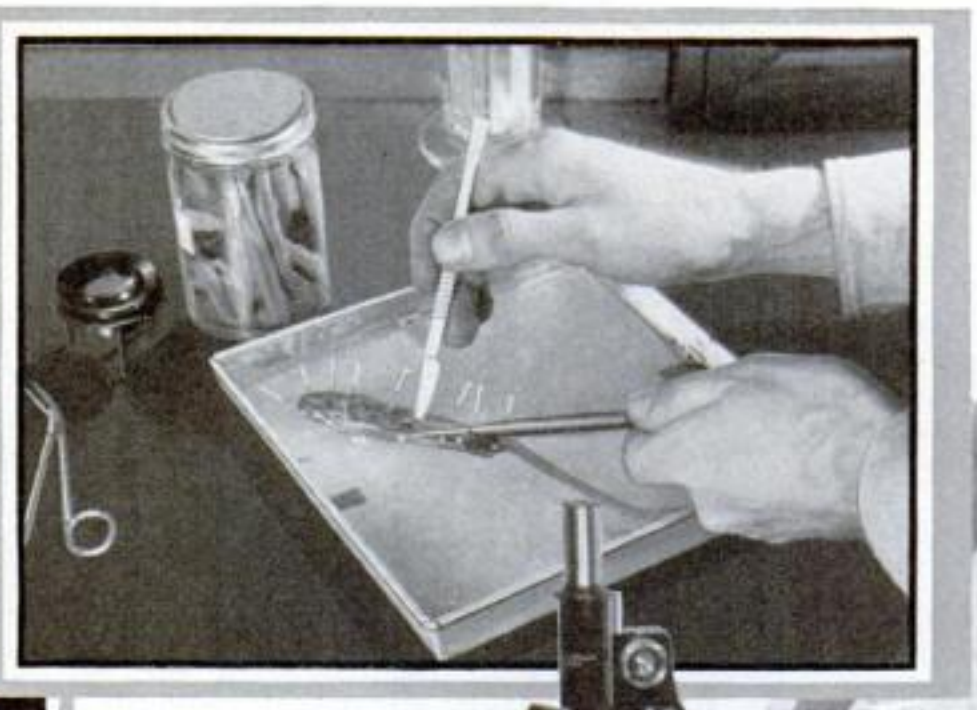


A new business thrives in Kansas. Removing dust from a lawn with a giant portable vacuum cleaner

Marvels of the Earthworm

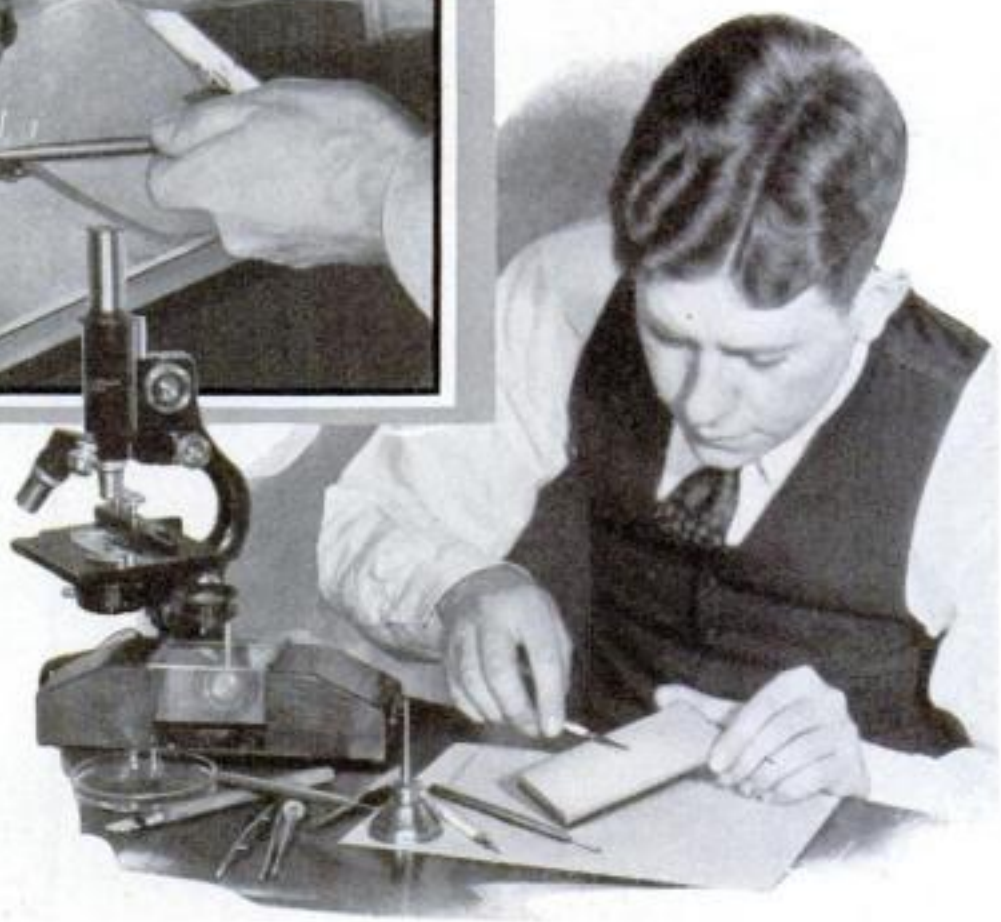
SHOWN BY YOUR MICROSCOPE

Left, a magnified view of a portion of the central nerve cord of the earthworm. Note the slight bulge and bundle of branches occurring at each segment of the worm's body



DISSECTING AN EARTHWORM

The body wall is split open and spread out flat, the edges being held down by pins as shown at the left. The work is done under water, in a shallow pan coated with paraffin. Below, sharpening a scalpel on a razor hone



THE man who first wrapped a cigar in transparent tissue probably thought he was doing something new, but the lowly earthworm, the well-known fishing worm or *Lumbricus terrestris*, beat him to it by countless thousands of years. For the earthworm, as dissection and your microscope will show, is wrapped in a thin, silky material of indescribable beauty.

Doubtless you have tried to pull a foot-long worm from its hole in the ground, and have been astonished to find out how difficult it was. More than likely, when you pulled it broke in two instead of coming out.

To the person not on intimate terms with worms, the ability of *Lumbricus* to anchor itself to the sides of its hole in the earth is puzzling. Other actions of this humble animal are equally baffling. For instance, when it is burrowing through the earth, how does it keep the rear half of its body from slipping as it forces its slender snout forward, and how does it keep the front end from sliding back while the rear half is being pulled forward?

Maybe you've guessed the answer: The worm has a remarkable system of tiny, glasslike "feet" or setae—four double rows of them along its body—which enable it to imitate a coarse-toothed file and to present a series of sharp points to the surface on which it is crawling. Your microscope will show these setae clearly, for they are fairly large, as microscopic objects go, being barely discernible to the naked eye against a dark background.

To see properly the peculiar wonders of the earthworm, you must become an earthworm surgeon, as it were. With scalpel and dissecting needle, you must open up the worm carefully, to reach the marvels that lie within. In doing this, you will be absorbing valuable knowledge about the structure of animals in general, for the earthworm is used almost universally as a model of the way in which nervous systems, circulatory systems, and other zoölogical mechanisms function.

If you never before have dissected a specimen of animal life, you may find your first venture an introduction to a distinct hobby, one closely allied with microscopy. It is by dissecting and examining all kinds of organisms that biologists and physiologists obtain their knowledge of structures of the lower animals, and even of man himself.

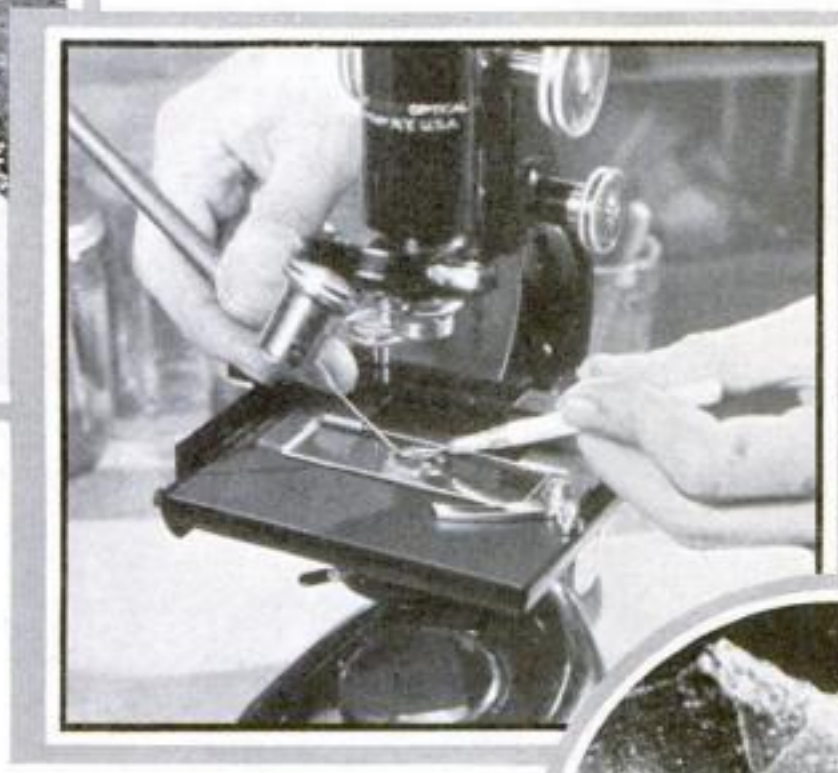
Get a good specimen, preferably a live worm so you can study its actions before putting it on the operating table. If the season or locality does not permit you to find your worms with a flash light at night, or in the daytime just after a rain, you can buy either live or preserved specimens from biological supply houses for about ten cents each.

You will find the live worms covered with slimy mucus, excreted through tiny openings in the bodies. This mucus serves as a lubricant to enable the worms to crawl through the earth with ease, and as a kind of cement to hold the walls of their burrows firm. The worms can be killed in a solution that is one tenth alcohol and nine tenths water. When the worm is dead, remove it, wash away any mucus and dirt clinging to it, and transfer it to the dissecting pan.

This is a shallow pan, costing about ten cents, into which paraffin is poured until it is three quarters of an inch from the top. Before melting the paraffin, however, solder L-shaped lugs of tin plate to the inner walls of the pan, arranging them so that they project one half inch or so toward the center. These lugs will anchor the paraffin "floor" in the pan. Otherwise, when water is poured into the pan, the paraffin cake will float. Melt the wax by setting the pan on a stove, and then let it cool, being sure that the pan is perfectly level. If you darken the wax with lampblack or powdered graphite, small bits of tissue will be seen against it more clearly than if it is left gray-white.

Dissecting is best done under water to which a little salt can be added, if desired. If the specimen is to be kept for several

How does an earthworm cling to the sides of its hole? The secret is revealed in the photomicrograph above, which shows a longitudinal section and one of the setae, or bristlelike feet with which the worm travels



Muscular tissue being torn apart to reveal muscle fiber under low-power magnification. The segmented outer wall of the worm's body is made of two layers of this tissue. The photomicrograph below shows a piece of the transparent cuticle, or wrapping, that covers the body. Near the center is seen an opening for one of the setae, or hairlike feet, passing through the skin

With Scalpel and Dissecting Needle, You Can Pry into the Secrets of Animal Life as Exemplified in One of the Most Amazing Creations of Nature

By MORTON C. WALLING

days, pour over it a preserving solution made by adding about an ounce of forty-percent formaldehyde to a pint of water.

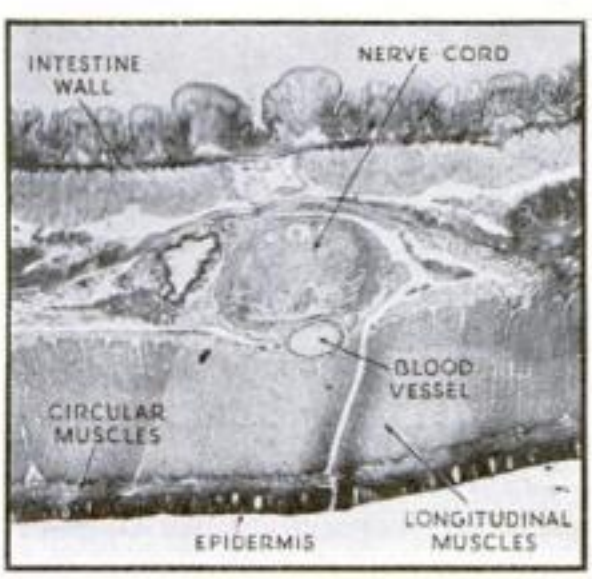
Have ready a dozen or more common pins. Put the worm on its belly, and push a pin through its snout, as near the end as possible. Then, with the dissecting knife—which can be a safety razor blade fastened in a suitable handle—make a shallow incision along the back, slightly to one side of the middle. Cut just deep enough to penetrate the body wall, but not deep enough to cut the intestine and other organs that lie just beneath it. As your cutting progresses, spread the body wall apart so that it lies flat on the paraffin, and stick pins through the edges, into the paraffin, to keep it flat. You will have to use the scalpel carefully to loosen the internal organs so that the body wall may be spread out flat.

THE structure of the earthworm, even though it is a relatively simple animal, is too complex to be described here in detail. Consult a good text as you proceed with dissecting.

When the first third of the worm is laid open, you will find that it contains a great many pieces of mechanism. Running from head to tail is the digestive system, made up progressively of the mouth, esophagus, crop, gizzard, and intestine. The intestine occupies the greatest part of the body length. Make a slit in it and remove, with tweezers, some of the material inside. Put it on a slide with a drop of water, and examine it through your microscope, to discover what the earthworm eats.

You can identify with ease shreds of grass and other vegetable material and grains of sand, which are commonly found.

Method of transferring some tissue to a slide for examination. Note how worm is held in place with straight pins



Cross section of lower portion of the body of an earthworm. Note how the nerve cord lies on the muscle tissue along floor of body cavity

Portion of a cross section through an earthworm showing how the upper part of the intestine is infolded to increase area

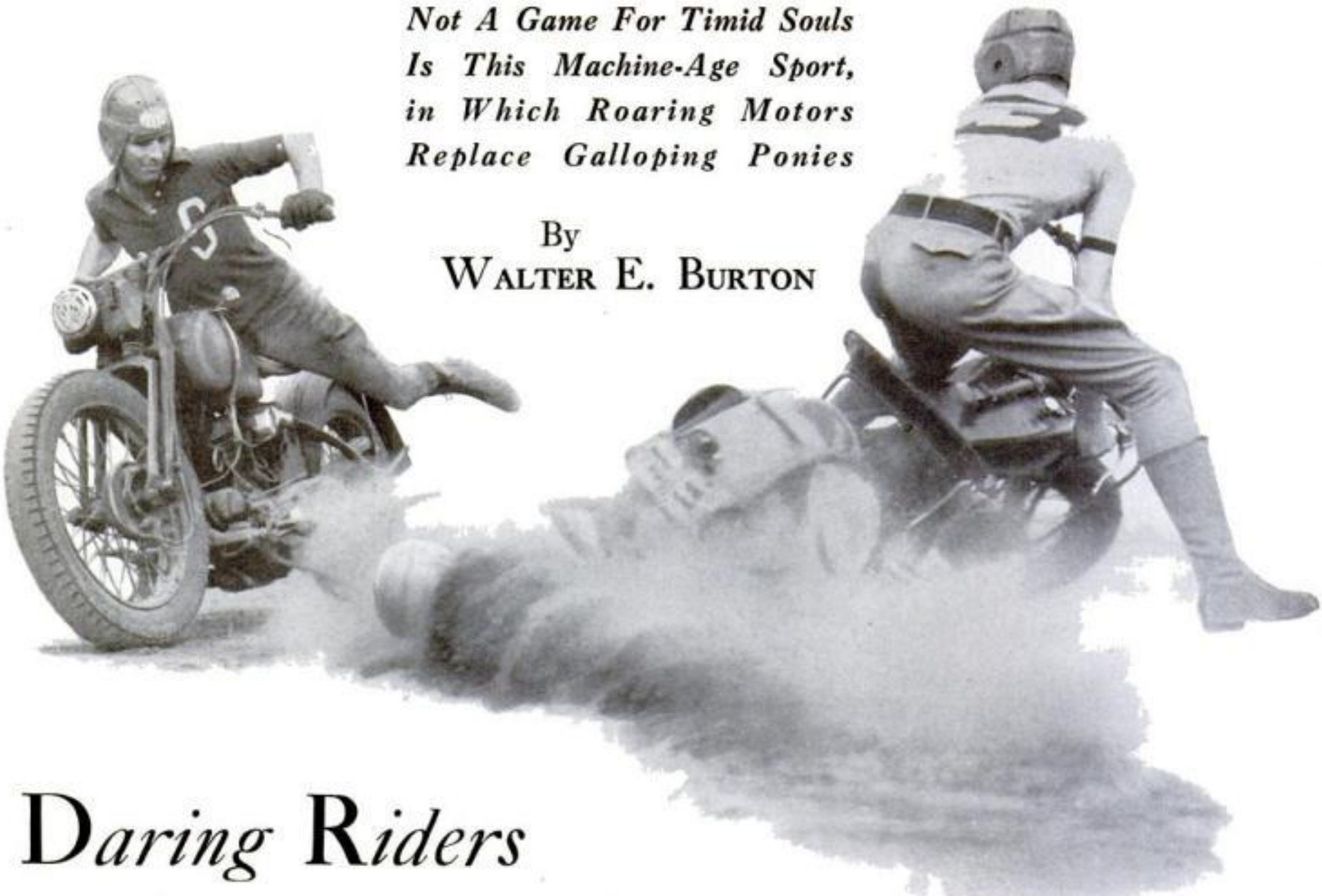
Keep that sand in mind, if you plan to make sections of the worm with a microtome.

The earthworm, you will observe, is essentially a double tube. The inner tube is the digestive system and the outer the body wall. Between these tubes are various organs such as the nerves, blood vessels, reproductive organs, of which the worm has both male and female: considerable muscular tissue, five pairs of hearts, and the nephidia or excretory organs.

With fine-pointed scissors, clip a small square from the body wall. Put it on a slide, outer surface uppermost, add a little water, and lay a clean cover glass over it. Examine the piece carefully with moderate power, say twenty-five to thirty-five diameters. Soon you will discover one of the tiny feet with which the earthworm grips the earth. These feet or setae occur in *(Continued on page 94)*

Not A Game For Timid Souls Is This Machine-Age Sport, in Which Roaring Motors Replace Galloping Ponies

By
WALTER E. BURTON



Daring Riders THRILL CROWDS WITH Polo *on* Motor Cycles

BEHIND a pair of slender goal posts at one end of a large field, five motor cycles are lined up abreast. The riders, tense with excitement, race their engines noisily. Across the field, a hundred yards away, a similar group stands waiting behind another goal. Exactly half way between the opposing teams, a referee places a standard soccer ball on the ground.

A timekeeper on the sidelines drops his yellow flag; the referee blows a shrill blast on his whistle. From one of the teams, a solitary rider darts forward and, swerving a little to one side of the ball, gives it a resounding kick that sends it soaring through the air. Immediately there is a roar of exhausts as the other machines spring into action. A game of motor-cycle polo, one of the most exciting of modern sports, is under way.

Polo on wheels is not a game for timid souls. Ten men dashing about a field on motor cycles weighing more than a quarter of a ton each, half of them trying to kick the ball one way and half the other, do not give the impression that they are engaging in a parlor sport. Scarcely a minute goes by in a typical motor-polo game without an exciting spill or an interesting tangle. Yet, surprisingly few skinned shins or bent spokes result. The fact that, on a restricted field and during normal play, there seldom is opportunity or necessity for a player to attain much speed, doubtless removes much of the danger from the sport. Nevertheless there are few games, either on wheels or off, that can rival motor-cycle polo for thrills and action.

A player following the ball across the field, with a teammate beside him and two members of the opposing team ready for a chance to interfere

This comparatively new game is, as yet, known to only a few sections of the country. It is spreading in popularity, so that almost every community where there is a motor-cycle club doubtless will become acquainted with it in the near future.

Although league and championship games are played in accordance with rules, and with equipment specified by the American Motor-Cycle Association, the average contest between local players, or between cyclists from neighboring communities, frequently is highly informal. For instance, the regulation polo motor cycle is a machine stripped of much of its standard equipment, yet games often are played with stock machines which have not been altered in any way.

The regulation motor-cycle polo field has maximum dimensions of 200 by 300 feet. Fourteen-foot goal posts, no larger than four inches in diameter, are placed twenty feet apart, at each end of the field. A semicircle with a radius extending out thirty-five feet from the center of the goal is drawn with lime or other material, to indicate the goalkeeper's zone. In the exact center of the field is a circle, from which the kick-off is made; fifty feet from each goal is a penalty circle for making penalty kicks.

Only one-seated machines are used in regulation playing. A short guard is employed on the rear wheel, and none at all on the front wheel. For safety's sake, chain guards are used front and rear. No skid chains are permitted on the tires.

FIVE players constitute the usual team, although the game can be played with less. The line-up of players includes a center, right forward or guard, left forward or guard, rear guard, and goalkeeper. At the start of each play, these men line up in definite formation behind their proper goals. The center occupies the center position, with the right and left guards on either side, respectively. The rear guard is at the right of the line, and the goalkeeper at the left.

With the exception of the center who makes the kick-off, no player is permitted to leave his position until the ball has been booted or passed by the center rider. Then all except the goalkeepers move out on the field and try to force the ball between the opponents' goal posts. The goalkeepers move around to a position from which they can dash across in front of the goal to block the ball if it comes dangerously near.

The goalkeeper is a privileged player. He is permitted to block the ball with his feet, hands, head, body, or motor cycle, as long as he remains on his machine and stays within the thirty-five-yard semicircle. Outside this zone, he may play the ball only with his feet or machine. The other players must use only their feet to play the ball, although they may block it with heads, shoulders, or elbows. Blocking with the machines, using hands, or holding the ball with a foot make them liable to penalties.

To see that these regulations are observed, there is a battery of officials, including the referee, whose hardest job is to keep up with the players while he travels, of necessity, on foot; two assistant referees who take positions at each goal post to pass upon the success or failure of goal attempts; four umpires, two from each side, who assist the referee, determine when a ball is out of bounds, and occasionally help restore a spilled rider to his mount. A timekeeper, with a yellow flag to signal beginning and end of each fifteen-minute quarter period, and a scorekeeper, are stationed at one side of the field. There is a five-minute intermission between quarters.

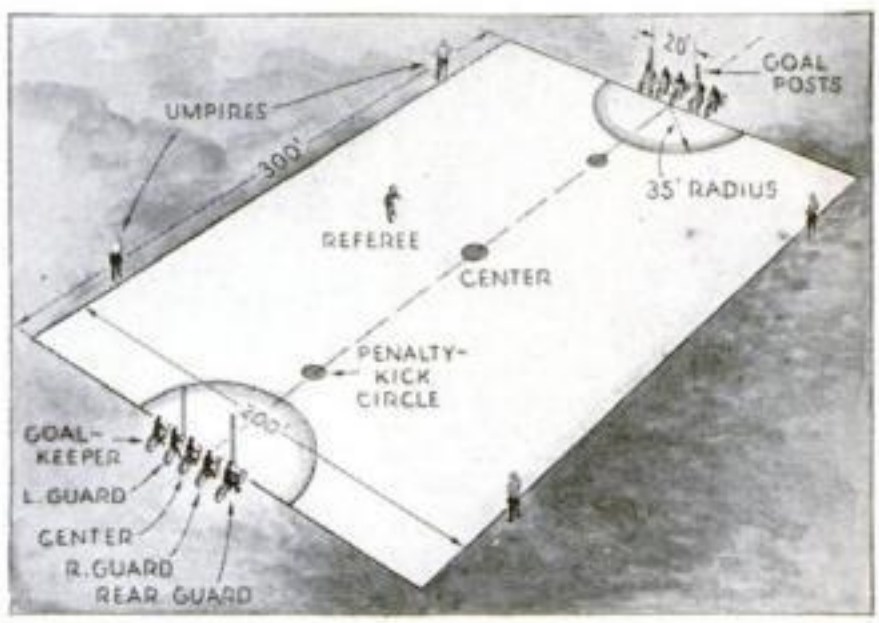
At the beginning of play, the two teams line up at their respective goal posts, and the referee places the ball in the center of the field. At the sound of his whistle, the center of the team kicking off rides down the field and attempts to boot the ball toward the opposing team's goal. Contact of his foot with the ball, or failure to contact, is the signal for the unleashing of plenty of action.

The two groups of players, with the exception of the goalkeepers, rush toward the ball, each man intent on forcing it down to the enemy goal, or preventing its being booted toward his own goal. The remarkable ease with which the players can avert crashes by hairbreadth margins, and the quickness with which they maneuver into position for kicking the ball or blocking an opposing kick, indicate the high degree of flexibility of the mounts no less than the skill of the players themselves.

Of course, the mad scramble for the soccer ball results occasionally in a mishap. Two machines may tangle, a rider may execute a tailspin too quickly and find himself and his mount sprawling on the ground, or some one may carelessly break off a goal post (which explains why the posts are no larger than four inches in diameter). Once in a while, a machine must be taken out because of mechanical difficulties. Sometimes, too, the ball is punctured and a new one has to be obtained.

When a ball is played across a boundary line, or when a penalty kick for the goal fails, an umpire or other official bounces the ball back into the field, and the playing continues. Infraction of rules may cause a team to be penalized, giving the opponents a chance to kick for the goal from the fifty-foot circle. Major violations may lead *(Continued on page 95)*

LAYOUT OF REGULATION MOTOR-CYCLE POLO FIELD



EXCITING MOMENTS IN A NEW SPORT

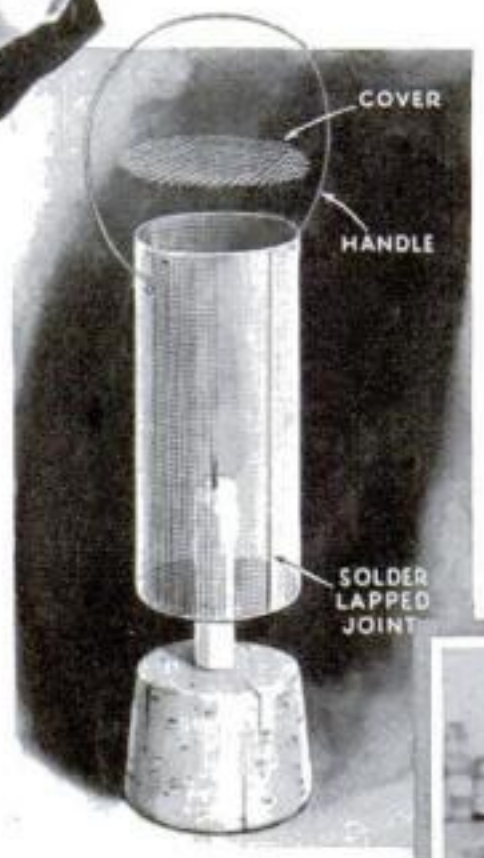
This is a hotly contested play near one of the goals. The referee, afoot, is blowing his whistle. Left, the goalkeeper blocks an attempt to make a goal. Unlike the other players, he is allowed to use his machine in blocking, and also his hands, head, or body

ENTERTAIN YOUR FRIENDS WITH THESE

SPECTACULAR Chemical Tricks

You can thrust a lighted Davy lamp upward into an inverted bowl of air and gas without fear of an explosion. The wire keeps the temperature below the ignition point

The model of the Davy safety lamp for miners, shown in each of the three pictures on this page, can be made simply by twisting a cylinder of wire gauze around a candle set in a cork, capping the cylinder with a disk of wire, and adding small handle



By Raymond B. Wailes

GLANCING over the rows of bottles and flasks in his home laboratory, every amateur chemist wonders, at one time or another, "What shall I do next?" Here are a few tests, selected at random, that afford interesting diversion when "stock" experiments pall.

How about making and trying out for yourself a model of the device that Sir Humphry Davy invented for miners, many years ago, which has come to be known as the Davy safety lamp? This important little invention removed the danger of inflammable coal gases being touched off by open-flame lamps carried by the miners. It consisted of an oil lamp with a cylinder of iron wire screen, about six inches high and an inch and a half in diameter, surrounding the flame. When an explosive air-gas mixture passed inside this screen, it would burn freely, but the flame could not pass outside, since dissipation of heat by the wire lowered the temperature below the ignition point. Thus the screen acted as a "flame sieve," without seriously obstructing the light.

You can easily make a model of this lamp. Simply roll a cylinder of wire screen of suitable size into a cylinder, place a cap over it, and thrust a cork in the lower end to carry a small candle of birthday-cake size. The fineness of the screen mesh plays an important part. Ordinary window screen, which has fourteen to sixteen wires to the inch, is too coarse to be used as a single layer and should be rolled upon itself about three times to reduce the free space between the wires. With screen of thirty mesh (thirty wires to the inch) or finer, only a single layer is needed for proper operation. The seam of the cylinder should be soldered or wired to keep it from unrolling; and the metal cap, cut to fit, may be soldered or wired on. With the addition of a wire handle, the lamp is complete.

Set up the lamp and play a stream of illuminating gas from a rubber tube upon it. The candle flame in the lamp grows in size, but the gas outside the lamp does not catch fire.

Try filling a wide-mouthed bottle or small bowl with illuminating gas, and inserting the lamp. Since the gas is lighter than air, fill the container by holding it upside down and letting the gas flow into it from the bottom. When the safety lamp is introduced from below, the flame becomes larger, as in the preceding experiment, but the surrounding gas is not ignited. To show that the mixture of gases around the lamp is explosive, place the bowl on a convenient stand and thrust a long, lighted taper up into it. The resulting flash shows what would happen if an exposed flame came in contact with gas in a mine shaft, though in this case the width of the mouth of the bowl avoids setting up a dangerous pressure of explosion proportions. Do not use a match, or you may singe an arm or coat sleeve.

If illuminating gas is not available in your home laboratory, you can make a substitute by pouring half a teaspoonful of gasoline or alcohol into an open bucket and shaking it to mix the vapors with the air. A lighted Davy safety lamp lowered into the bucket will not ignite the explosive air and gasoline-vapor mixture.

So efficient is this preventive of mine explosions that a stream of inflammable gas can be played upon it with safety

MAKING *a model of the Davy miner's lamp is only one of many stunts with flame and color you can perform easily in a home laboratory*

A strange purple glow results when you perform the test above. Dip a water-filled test tube in sulphuric acid, then heat it

Have you ever tried preparing any of the fascinating, mysterious compounds that glow in the dark? Home chemists are not always successful in making these "phosphors," or phosphorescent substances, but here is a pretty experiment that always works. Strong sulphuric acid is the only chemical you will need.

Fill a test tube with cold water, and immerse the tube in a small quantity of the acid. Remove the test tube and let the excess acid drop off, leaving a trace of it clinging to the outside of the glass. Now hold the tube in the blue flame of a Bunsen burner.

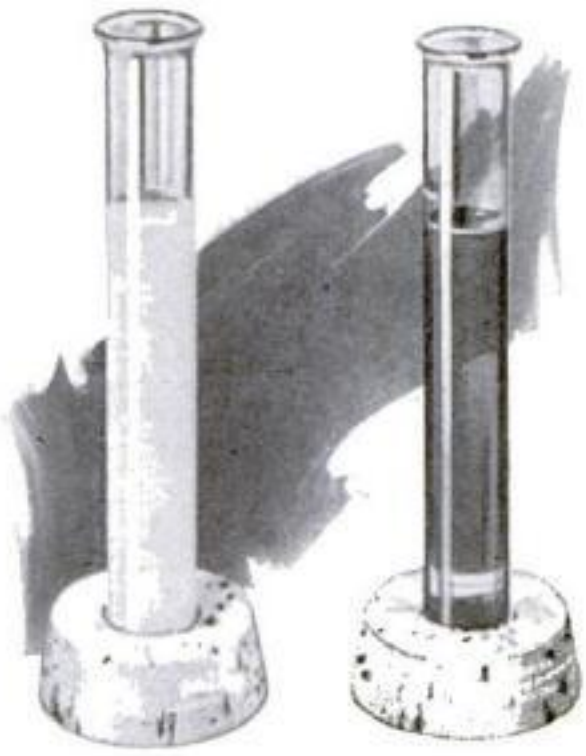
Immediately the outside of the test tube glows with a purplish light. In a partly darkened room, the effect is striking. A "soft" Bunsen flame should be used—that is, one which receives just enough air to make it blue and no more. Do not hold the tube in the flame too long, or it may break.

It has been suggested that the purple luminescence comes from the oxidation of sulphur in the sulphuric acid, the sulphur being liberated by the reducing action upon sulphuric acid of atomic hydrogen in the burner flame. The water in the tube simply prevents overheating.

Sometimes a similar luminescence may be observed with phosphoric acid or sulphurous acid. If you care to try this out, you can prepare your own sulphurous acid, which is the product that you will have after bubbling sulphur dioxide gas through water.

Your Bunsen burner may be made to play several color tricks with compounds of zinc. One of these is zinc carbonate, which you can prepare in practically pure form by adding a solution of sodium carbonate to a solution of zinc sulphate or of zinc nitrate. Filter off the white precipitate and wash it seven or eight times with water while it is still on the filter paper.

When this zinc carbonate is heated in a crucible or evaporating dish, or on an iron plate, it loses carbon dioxide and turns into zinc oxide. While it is hot, the color is yellow, but it becomes white again as it cools to room temperature. In fact, this compound is used as a white pigment and is sold under the name of Chinese white.



Mix some kaolin with water and pour the milky solution into two test tubes. Add a base to one and an acid to the other. The acid solution will settle out, while the other will not

Zinc ferricyanide changes color from white, at room temperature, to green when heated. Like the preceding compound, it can be prepared from a solution of zinc sulphate or zinc nitrate. Add a solution of potassium or sodium ferricyanide, and you will obtain a voluminous precipitate which can be washed by decantation and then filtered, or filtered off first and then washed. Washing the last two precipitates is necessary to remove soluble chemicals that would otherwise contaminate the product.

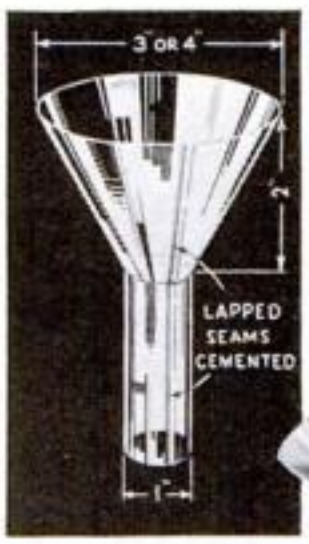
You can perform another interesting trick with the Bunsen flame by wafting it across the surface of a solution of silver nitrate, which has been placed in a porcelain evaporating dish or crucible. In about five seconds the surface of the liquid becomes discolored, and you will find it covered with an extremely thin film of metallic silver particles. The liquid itself has turned a grayish green. It contains what are known as "colloidal" particles, which will remain without settling out for a considerable time. Their presence may be shown by letting light fall upon the liquid after passing through a pinhole in a card. The bright beam in the liquid is caused by reflection of light from the particles.

If you wish, you can prepare the silver nitrate solution for this experiment by dissolving a small crystal of the solid substance in distilled water. Tap water should not be used, since it contains chlorides that would cause a precipitate of silver chloride. The solution should always be kept in a glass-stoppered bottle, as it is destroyed by contact with a cork stopper.

If you obtain some white china clay, which can be purchased under the name of kaolin, and shake a pinch of it with a bottleful of water, you will have a suspension of clay particles that shows a curious (Continued on page 104)

Celluloid Funnel for Pouring Powder

THE FUNNEL shown will help you pour light, fluffy powders from one carton to another, or to fill bottles for your shelves of chemicals. It is made of celluloid and is cemented with any standard celluloid cement or with a solution of celluloid in acetone or amyl acetate. Either thin sheet celluloid or a thicker material may be used, as it does not matter whether the funnel holds its shape. Its large diameter aids in handling powdery substances. After use, the funnel may be rinsed with water to remove adhering particles. Do not, however, expose it to warm water for any great length of time; the heat will tend to soften the celluloid.



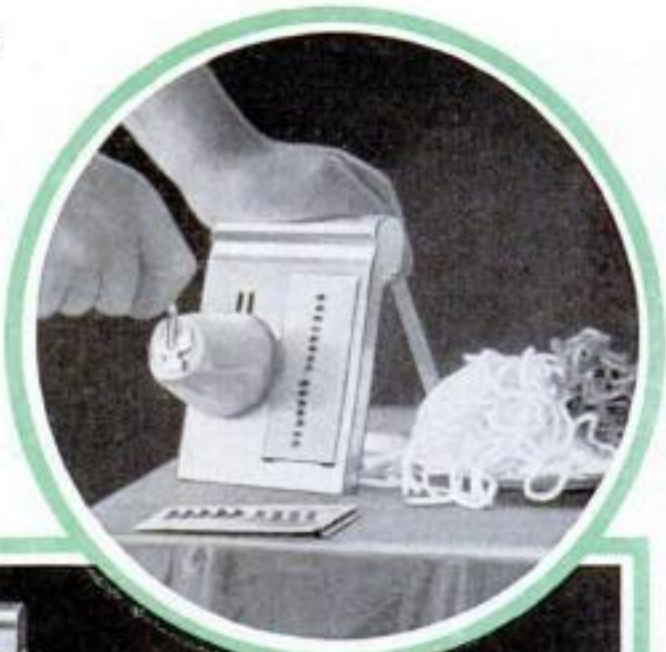
Give the funnel a wide mouth and lap the seams as shown in the diagram

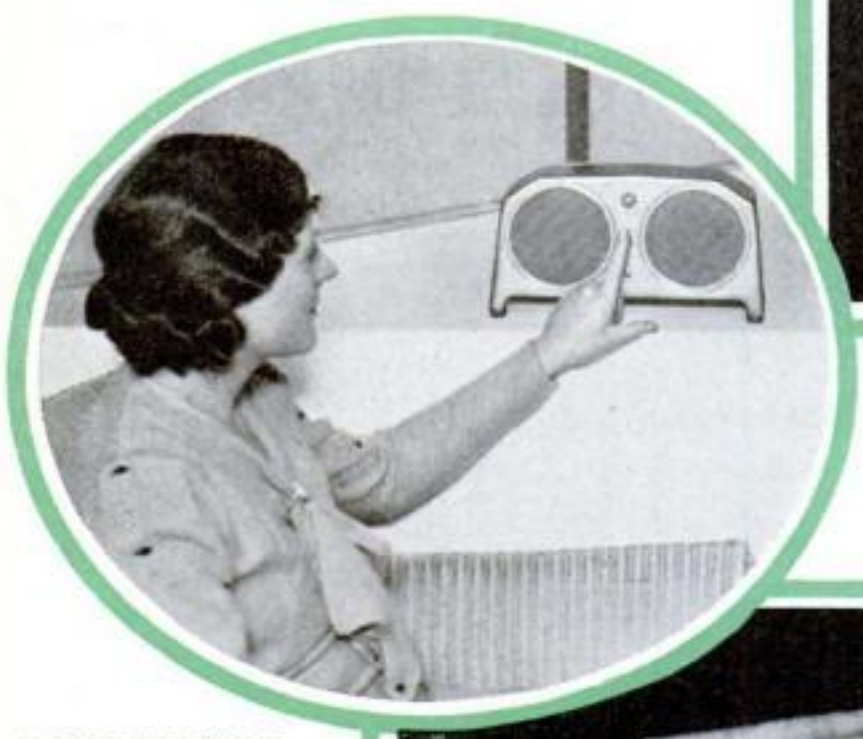
New Devices for

DOUBLE-DOOR REFRIGERATOR. The inner door of this new refrigerator provides a space where the small food items most frequently needed may be stored conveniently. Both time and current are saved by this arrangement, since it is seldom necessary to open the inner door

VEGETABLE SLICER AND SHREDDER

With the turning of a crank, this efficient new kitchen appliance shreds or slices vegetables as fine or as thin as desired. The vegetable is peeled, if necessary, and then pierced through the center with the crank stem. The end of the stem is inserted into a hole in the oblique plate, and the vegetable turned against the plate or slicing blade





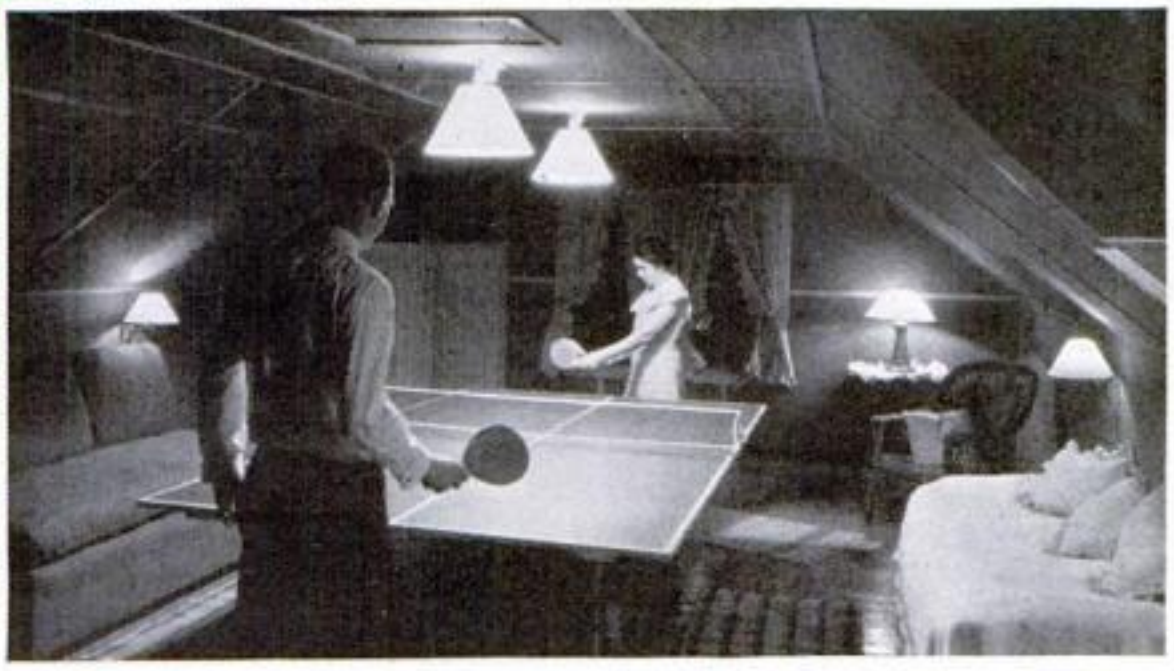
LOUDSPEAKER TELEPHONE. A microphone in this new home instrument picks up the speaker's voice, while a loudspeaker amplifies the signals from the other station

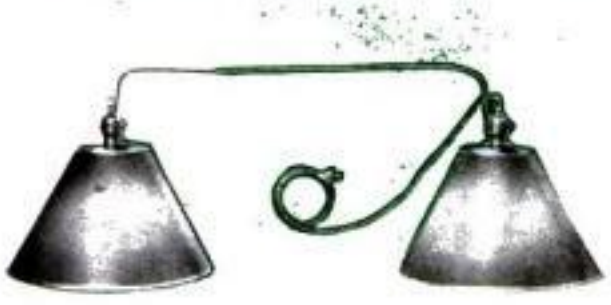
STRAIGHTENS JAR LIDS. Fruit-jar lids that have become bent may be straightened and sealed on the jars by the use of this device. Rollers inside the octagon shell smooth flange of lid

MONOGRAMS supplied on tissue sheets can be transferred to any article of cloth or leather by pressing with a hot iron. The resulting impression withstands laundering

MAGAZINE RACK IN ARM OF CHAIR. Built into the arm rests of this upholstered easy chair are pockets for storing a supply of magazines. A catch on the side releases the panel, allowing the magazine compartment to be opened as shown. The pockets do not detract from the appearance of the chair

Modern Homes





LIGHT FOR GAME TABLE. Adequate lighting for games such as table tennis and billiards is afforded by an outfit which includes two parchment-paper shades, complete wire assembly, fixture loops, and ceiling hooks. Installation can be made by anyone in a few minutes, the rubber cord being plugged into any convenient ceiling outlet. It is also easily taken down

RUBBER-BALL BOTTLE STOPPER SNAPS ON

The unscrewing or pulling of corks is made unnecessary by this ingenious bottle stopper. Made entirely of rubber, it fits any bottle neck and snaps on or off the mouth at the touch of a finger

Clipped onto the edge of the regular dinner plate, this auxiliary dish also holds relish, crackers, or butter. Because of its curved shape, it saves valuable table space

INDIVIDUAL DISH FOR BONES

When serving fish, fowl, or steaks, the hostess will find this curved bone dish a convenience appreciated by her guests. It can also be used for many other individual-service purposes

AUTOMATIC DOOR LIGHTS

When a visitor steps on the door mat of this home, the illuminated house number and two side panels flash on. A button controls a keyhole light

HOSE COUPLING. One section of the hose coupling shown at the left is attached to the hose; the other stays permanently on the faucet. In connecting the hose, the sections are locked together with the eccentric lever

NON-STICK COASTERS

Small metal frames set in the coasters at the left keeps them from sticking to the wet bottoms of tumblers or highball glasses. They also serve as ash receivers

Question: Is it true that a wolf's eyes differ from those of a dog?—B. H., Providence, R. I.

Here's *the* Answer

A.—THE PUPILS, or iris openings, of the wolf's eyes are oblique slits. The pupils of the dog's eyes are round, while those of the fox and the jackal have vertical pupils. It is this peculiarity that gives the wolf his sinister expression.

Not a Close-Up

G. E. B., ROCHESTER, N. Y. In the field of distance photography, one of the longest shots on record was made by an Army photographer from an airplane at an altitude of 23,000 feet near Salinas, Calif. The camera lens caught the peak of Mt. Shasta, 331 miles away.

The Grocer's Friend

Q.—WHO INVENTED the paper bag?—S. J., Richmond, Va.

A.—A PATENT on the paper bag was issued to a woman, Miss M. E. Knight.

The Aristocratic Race Horse

W. O. H., GLACIER PARK, MONT. All thoroughbred race horses are descendants of three famous mounts: the Byerly Turk, a charger ridden by a Captain Byerly in King William's wars; the Godolphin "Arabian," thought to have been a Barb, and the Darley Arabian, which was imported into England from Aleppo, Syria. All three of these mounts were male horses. The mares used in the breeding of the famous thoroughbred were native English mares, probably descended from the sturdy and fast-running horses that drew the scythe-chariots of the early Britons, as reported in Caesar's "De Bello Gallico."

The Band in Your Hat

Q.—WHY DOES a man's hat have a little white bow inside at the back of the headband? It isn't of any use, as far as I can see. —K. D., Detroit, Mich.

A.—MEN'S HATS, a few centuries ago, were made of heavy steel. Consequently, for comfort, the wearers placed circular padding inside. This padding was fastened with a bow in the back, so placed in order that it would not press upon the forehead. The little white bow is therefore a relic of feudalism. The circular padding is still worn today in the shrapnel helmet of the Army.

Tides and Undertows

G. S. S., ATLANTIC CITY, N. J. The cause of the undertow in the surf is primarily the sequence of tides and waves. A wave forced up on the beach must recede. As it recedes, a second wave, rushing forward, breaks over it. This action is repeated so often that a constant undercurrent, receding toward the deep water, is formed.

Too Small To Hold Air

Q.—IF THE moon has enough power to cause ocean tides on the Earth, why can't it hold an atmosphere as the Earth does?—C. J., Deerwood, Minn.

A.—IT IS the size of the moon that prevents it from holding an atmosphere. Its diameter is but 2,159.6 miles, just one quarter of the earth's diameter. It is described as "a world spoiled in the making."

Count 'em Yourself and See

Q.—PLUCKING a turkey for last Sunday's dinner brought this question to my mind. Can you tell me how many feathers a turkey has?—Mrs. C. M. B., Vancouver, B. C.

A.—On the average, a turkey has 3,860 feathers.

Official Sunrise

Q.—WHAT IS it that determines the exact time of sunrise?—E. T., Flushing, L. I.

A.—THE NAVY Department, through its nautical almanac, gives out the time of sunrise for each day. The moment chosen is that at which the sun's lower rim stands on the true horizon. Because of the diffraction of light rays by the earth's atmosphere, the sun is not seen in such a position at the particular time designated, although it actually is there.

Bridge of Ice

E. R. R., JERSEY CITY, N. J. Railroads have been run across ice eighteen inches thick. Lake Baikal, in Siberia, has carried the tracks of the Trans-Siberian Railroad during the winter months. Sea ice, however, is plastic, and will not support much weight unless it is very thick.

A Short Life but a Merry One

Q.—WHAT IS considered to be the "lifetime" of an automobile?—H. F. C., Winnemucca, Nev.

A.—AN AUTOMOBILE has an average useful period of about seven years.

Fake Jewelry

H. L., LAMBERTON, MINN. Strass, a lead glass, is used as the basis of most artificial gems. It looks like the diamond, but will not, of course, withstand the diamond tests. Coloring agents are added during manufacture.

Homemade Tooth Paste

A. A. M., WALLA WALLA, WASH. Here is a formula for tooth paste: calcium carbonate, levigated, 100 parts; cuttlefish bone, in fine powder, twenty-five parts; old, white, powdered Castile soap, twenty-five parts; tincture of carmine, ammoniated, four parts; simple syrup, twenty-five parts; menthol, two parts, alcohol, five parts, and rose water sufficient to make a paste, which can be put into tubes.

Air and Life

Q.—ARE THE rare gases such as helium, argon, neon, krypton, and xenon in the air we breathe essential to life?—H. O., Montreal, Que., Canada.

A.—NOT IF the results of recent scientific tests mean anything. Laboratory mice, provided with an atmosphere lacking all of these rare gases, were healthy and lively after forty days.

Noise from the Sky

Q.—IS THE motor or the propeller of an airplane responsible for the larger portion of the noise heard by a person on the ground?—A. N., Newark, N. J.

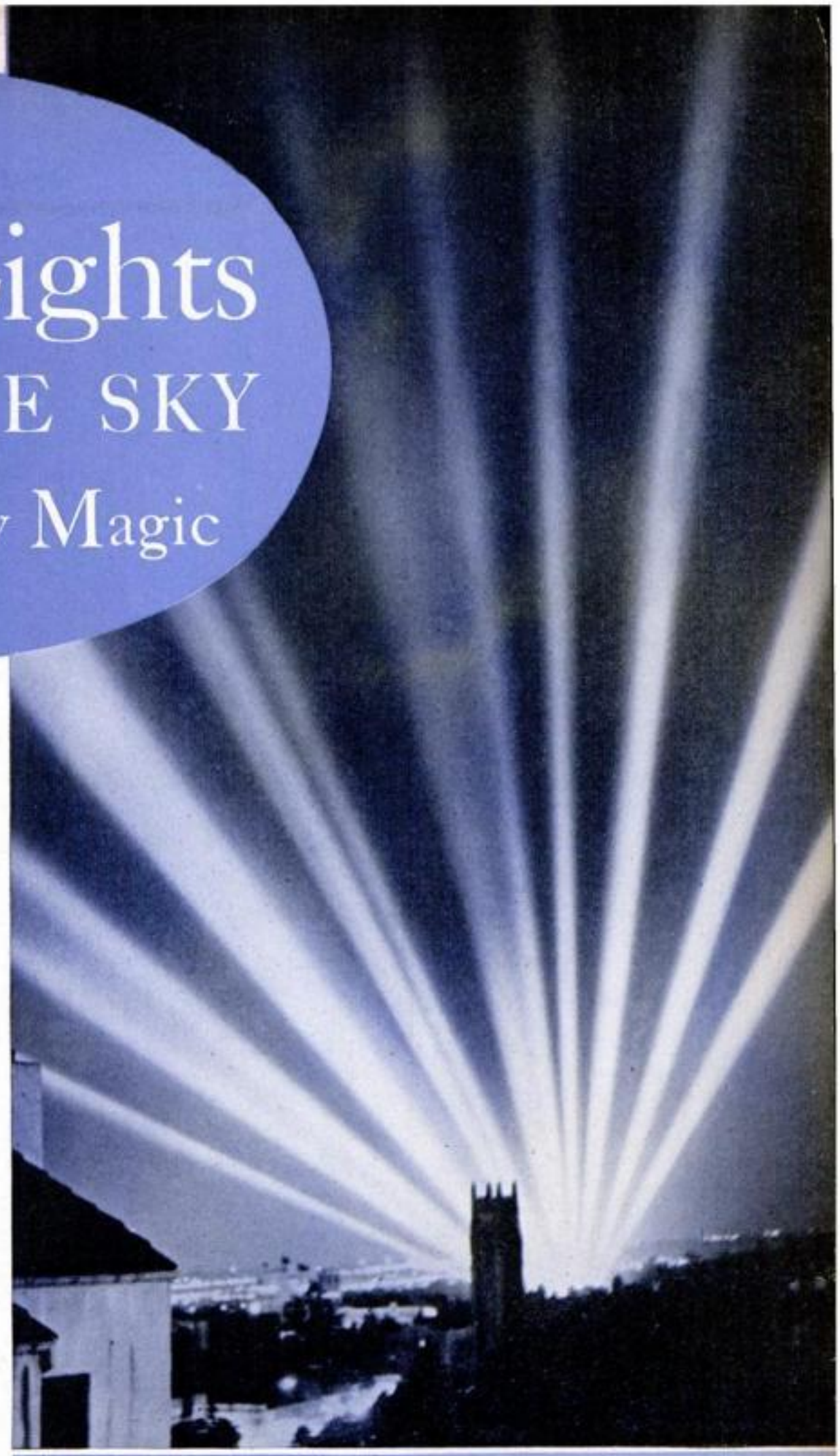
A.—ANTI-AIRCRAFT listening devices hear first the rhythmic sound of the motor; because this sound pulsates more distinctly, it is the more easily heard, and therefore the louder.

Fish Have Reverse Gear

Q.—CAN FISH swim backwards?—C. S., Keighley, Yorkshire, England.

A.—YES, AND they often do, but never for more than a short *(Continued on page 104)*

Giant Lights PAINT THE SKY To Work New Magic



ABOVE Hollywood, the night sky was ablaze. Great rainbow beams—red, violet, yellow, blue, green—played across the heavens like the folding and unfolding of a gigantic fan. Five billion candle-power were being flung against the sky to create the spectacular illusion of the aurora borealis, brought to Southern California through the wizardry of a lighting engineer.

He had ranged fourteen huge searchlights in a semicircle, so that their beams spread, like the ribs of a fan, from a single point. Translucent screens, placed before the lights, gave them the brilliant hues of the aurora. Still other search-lights, constantly sweeping back and forth, made the colors ebb and flow like the weirdly pulsating beams seen in the polar regions.

Three times has this artificial aurora borealis been created to signalize some event of local importance. Each time, people from miles around have flooded the newspaper offices with telephone calls, asking about the mysterious display of "northern lights." In actual tests, the white beams were visible for sixty-five miles, while the color screens were found to reduce the visibility by forty percent.

Creating such spectacular displays on a huge scale is the unique occupation of Otto K. Olesen, of Hollywood. "We light the world!" is his slogan, and in working this magic he uses a

The northern lights brought to Southern California through the wizardry of modern engineering. Fourteen mammoth searchlights, like the one seen in the illustration at the left, were employed to create this beautiful spectacle

HOW ILLUMINATING EXPERTS USE PORTABLE EQUIPMENT TO CREATE STRIKING AND BEAUTIFUL NIGHT DISPLAYS

By *Sterling Gleason*

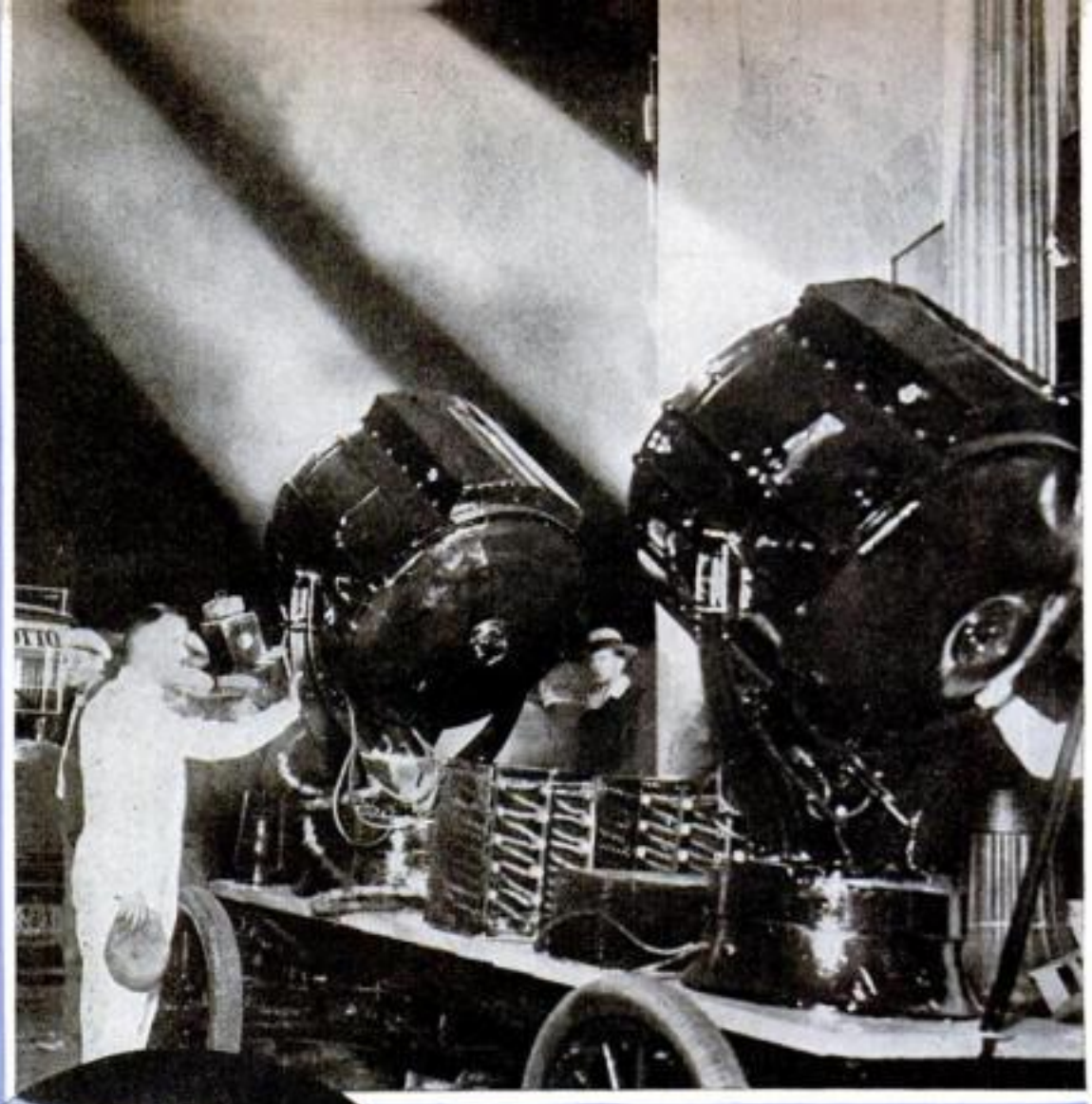
whole arsenal of fantastic instruments. His Hollywood warehouse stables an army of giant truck-mounted searchlights—great behemoths rated at 325,000,000 candlepower each; dozens of sunlike arc floodlights, burning chemically cored carbons; a battery of the latest gas-filled, highly concentrated incandescents, with chromium-plated mirrors to reflect their beams without loss; a whole nursery of baby spotlights, and dozens of larger ones ranging up to thirty-six inches in diameter.

AIDING in the work is a fleet of thundering power trucks, each using a high-speed gasoline motor to turn a generator which pours as much as 200 amperes into snaky rubber-covered cables as thick as a man's wrist. Each power plant drinks gasoline at the rate of from five to twenty gallons an hour, and has a massive nickel-barred radiator to dispel the heat generated.

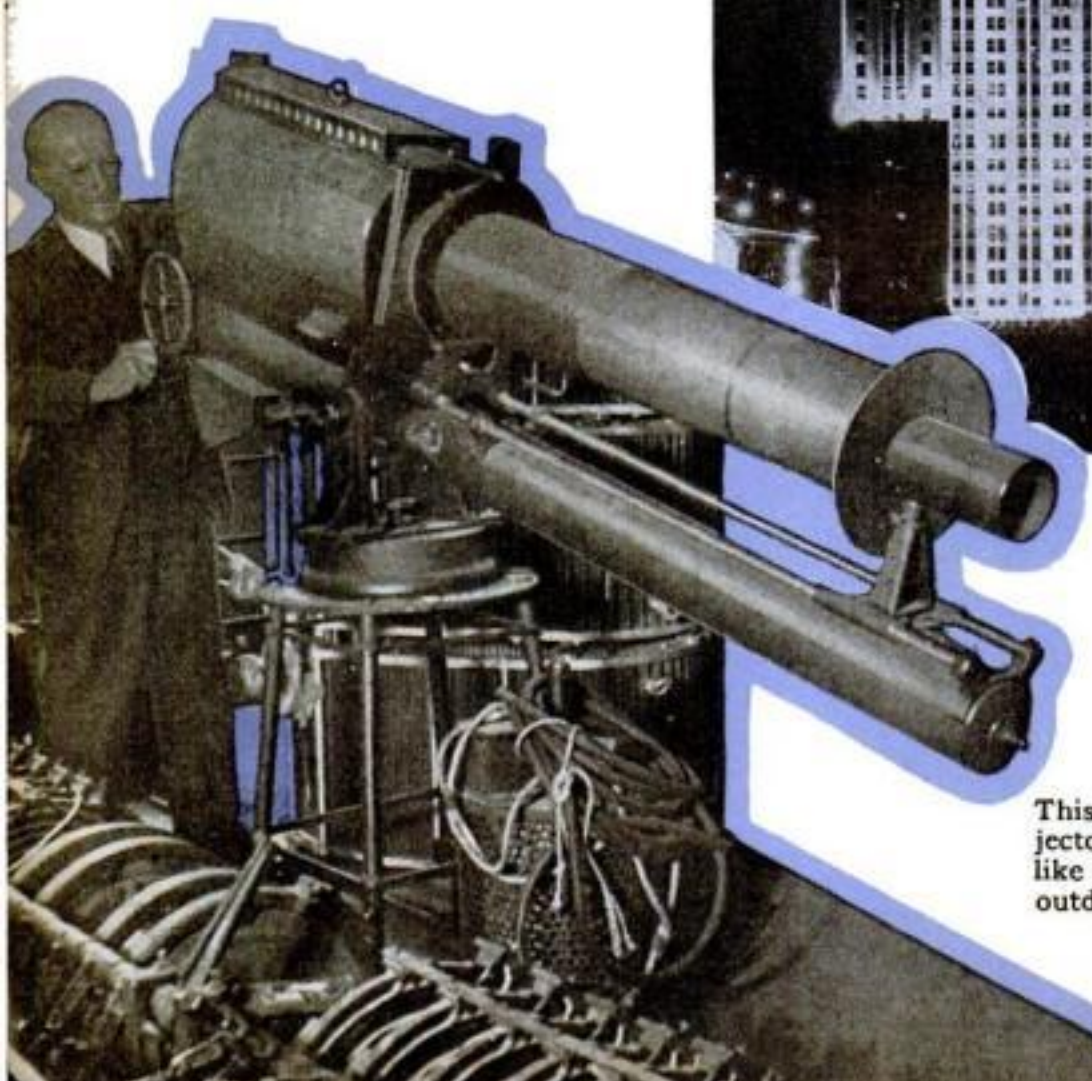
In other parts of the country, other experts also are marshaling batteries of high-powered lights to achieve spectacular effects. During the George Washington Bicentennial celebration in New York, for example, the Kliegl brothers, originators of the Klieg light, studded skyscrapers surrounding Bryant Park with more than 200 long-distance floodlights to illuminate the area.

This concern has taken hundreds of queer lighting contracts which range from illuminating an underground cavern for subway workers to lighting the Polo Grounds for a pageant. One of their concentrated-beam lamps even rode with William Beebe when his bathysphere descended to a record depth of 3,028 feet below the surface of the sea. Its penetrating beam enabled the scientist to photograph strange forms of life found in the eternal darkness of these lower levels.

Probably the peak in modern lighting effects was reached during the recent Chicago World's Fair where "painting" with colored light on colored surfaces produced some of the most spectacular of the displays.



Probing the night sky with fingers of light, these lamps aid in a demonstration



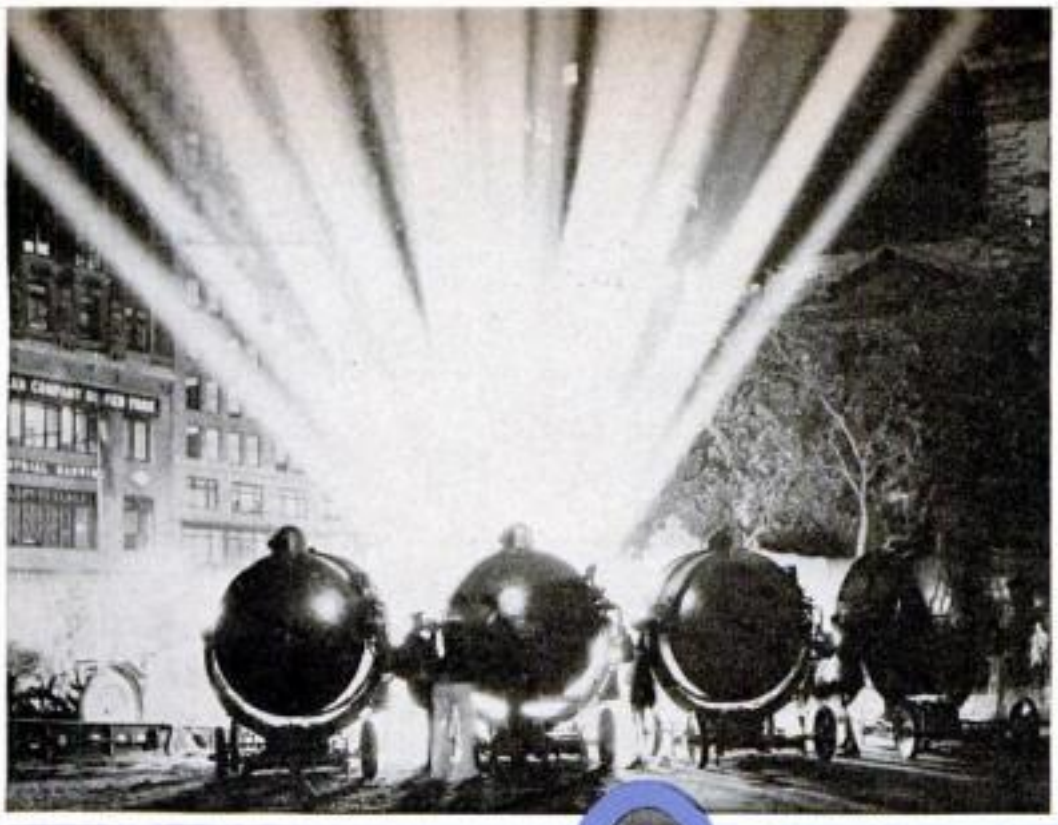
The most powerful light in the world, the Lindbergh Beacon, on a Chicago tower

This high-powered projector casts a needle-like beam of light for outdoor scenic effects

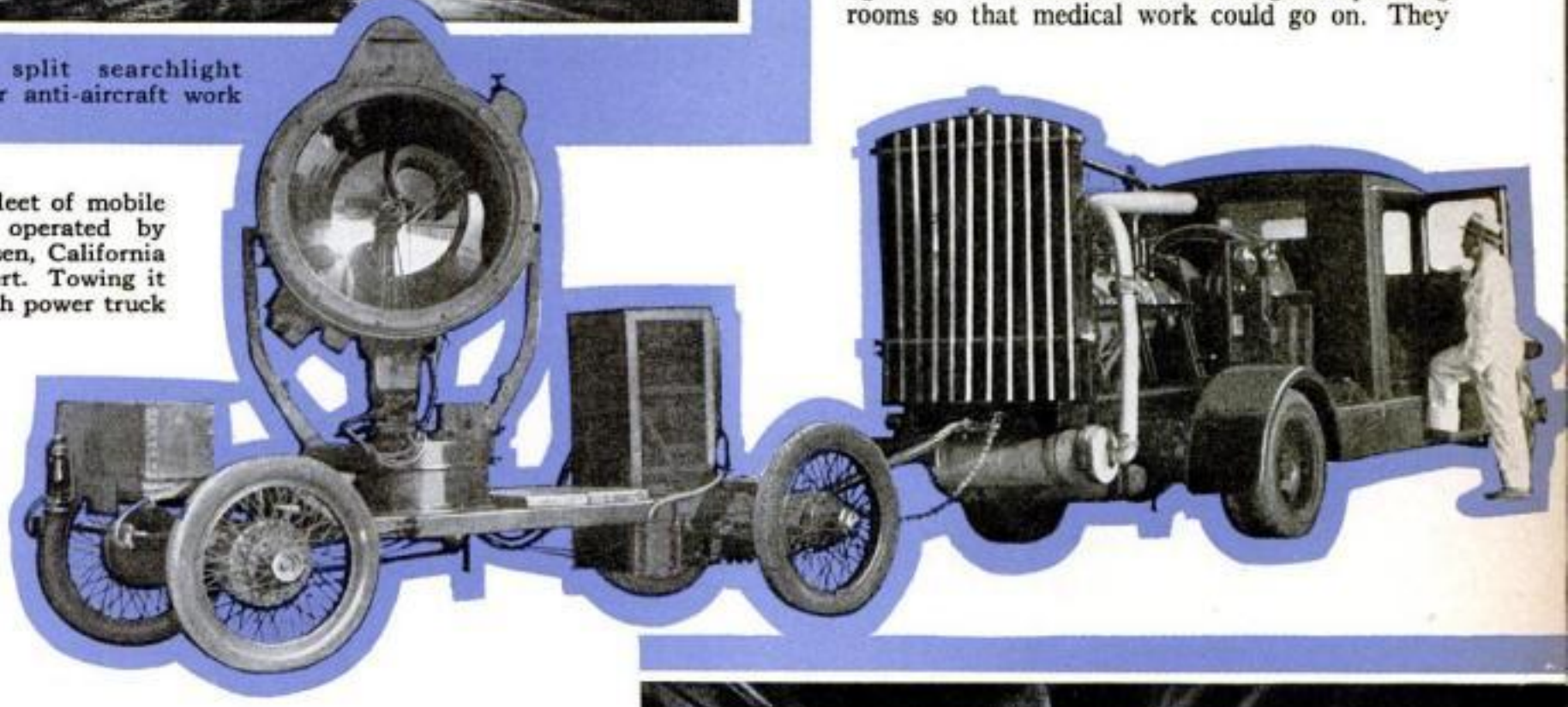
Another outstanding achievement in recent months was bathing the gigantic bulk of Boulder Dam with rainbow hues to mark the creation of a huge man-made lake running back 125 miles into the Colorado plateaus. To accomplish this feat, Olesen, the California expert, shipped a whole carload of equipment from his Hollywood storerooms.

At the dam, a "high-line" aerial tramway swung a bank of big transformers out over the gigantic structure and set them in place for the huge alternating-current incandescents. Giant searchlights were hoisted to strategic points, floodlights perched at picked locations, colored gelatin transparencies clamped into place. Half a mile from the dam, a powerful, long-range stereopticon projector was set up with its lens trained on the face of the structure. This machine required an astonishingly heavy supply of direct current—enough to run an elevator or hoist. Olesen powered it by tapping an electric railway and running a line far down the mountain wall.

At midnight, all lights were turned out, leaving the canyon in pitch darkness. At the throw of a switch, brilliant rainbow hues bathed the walls of the canyon and lighted up the giant intake towers rising 1,200 feet from the cavernous river bottom. As the ceremony proceeded, gorgeous color combinations played over the massive structure, converting its huge bulk into a fairyland of lights. Finally, as the display reached a climax, Olesen switched on the stereopticon projector. From its tiny slide, only two and one half inches square, leaped a huge image—an American flag, brilliantly projected upon the concrete face of the dam itself. Thrown 2,000 feet, it was enlarged 9,000,000 times.



Mirrors split searchlight beams for anti-aircraft work



One of the fleet of mobile searchlights operated by Otto K. Olesen, California lighting expert. Towing it is a mammoth power truck

Geometry plus experimentation enabled Olesen to perfect a unique lighting system for night auto racing at Ascot speedway. Three problems confronted him: to provide enough light without throwing it into drivers' eyes; to avoid troublesome shadows; and to guard against power failure. On this track, the average qualification time is seventy-five miles per hour, and a driver traveling at this speed—110 feet per second—would have no chance at all if the lights should suddenly go out.

TO THE first problem he applied geometrical principles. Placing the lights high in the air shortened the shadows; locating them at the geometrical center of the track, caused their beams to fall so that the shadow is always on the driver's right as he makes his turns to the left.

To insure a continuous supply of current, he took the power supply from the lines of two independent companies, each running its own line into the speedway. Lights then were connected alternately to the two sources, so that if one source failed, half the lights still would be burning. Meanwhile, the switch would be thrown over instantly to connect all lights with the remaining power source.

During the past few years, scientific lighting has become a vital factor in other sports as well as in auto racing. Midnight golf is now possible on one western course and floodlight football, baseball, and tennis are becoming common. The National League has authorized a certain number of league baseball games to be played at night. Coaches and athletic directors from such widely separated states as Texas, Pennsylvania, Wisconsin, Georgia, and Minnesota have reported that night contests are proving more profitable and popular than those held in the daytime.

At Chicago, Ill., and several other American cities, special "light trucks" now aid firemen in battling flames. Equipped with generators spun by gasoline engines, the trucks have swivel searchlights mounted on top. These can be swung in any direction to play their beams over a blazing structure. Under such conditions, "all fires are fought in the daytime." The brilliant illumination helps officials to judge when walls and timbers will fall, and decreases the danger of firemen stumbling over objects or falling down open shafts.

In other emergencies on land and sea—in floods, earthquakes, hurricanes, shipwrecks, and ocean rescues—the searchlight and the floodlight in the hands of experts play a vital part.

During the Long Beach, Calif., earthquake of March, 1933, the horror of darkness added to the terrors of rocking buildings and falling masonry. All electric lines were dead. Hospitals still standing had no lights by which to aid the injured.

The sheriff's office immediately telephoned Hollywood's lighting expert, Olesen. He rushed a number of power plants to the scene. His men ran cables into the hospitals and set up floodlights in the corridors and in surgical operating rooms so that medical work could go on. They

Motion-picture premieres in Hollywood make work for lighting experts. In this picture a battery of giant lights is seen in action on a street of the movie city

A single operator works two large searchlights in a big-scale lighting effect. In spite of the great size of the lamps, they are so delicately balanced that they are moved easily by hand

Although designed for display work, the huge lights give invaluable service in time of disaster. This picture shows floodlights and searchlights in use after an earthquake

illuminated the key points of rescue work.

A year later, Olesen again aided victims of a major disaster. A January rain storm was battering Los Angeles, when, about midnight, near the suburb of Montrose, a wall of water released from a mountain pocket, raced down the mountain side with its load of rocks and mud, smashing through houses and crushing dozens of people in the wreckage.

In his Hollywood home, Olesen was listening to a radio program when it was interrupted and a voice said, "If Otto K. Olesen hears this, will he come to the aid of Montrose? We need light!"

Calling as many of his men as he could reach, he hurried huge searchlights to the scene. Under their brilliant illumination, sheriff's deputies combed the ruins for survivors of the disaster.

So large a concentration of light has great military usefulness, and Olesen's equipment forms an official part of the U. S. Naval Reserve, held in readiness in case of emergency. For example, if enemy airplanes should suddenly raid Southern California, Olesen's fleet of mobile searchlights could instantly be set to locate them.

The vital part "searchlight artillery" will play in a future war is so well recognized that the U. S. Army has ordered 104 of the most powerful lights in existence. Using those already delivered, crack military operators are probing the night sky in various parts of the country in practice anti-aircraft maneuvers.

Each of the new searchlights sends out a blinding beam of 800,000,000 candlepower and is capable of picking up an enemy plane flying at an altitude of three miles. Constructed of aluminum alloy, most of the new lights are to be mounted on wheels and towed behind trucks equipped with mammoth gasoline-driven generators.

Another development in this field is a split-beam searchlight. Perfected at Fort Totten, N. Y., recently, the light of the apparatus is directed parallel to the ground into a tilted mirror divided into segments. Each segment is set at a different angle so the main shaft of light is split into nine separate high-intensity beams shooting upward into the sky. Special blowers remove the gases and cool the 800,000,000-candlepower searchlight.

More than twice as powerful is the Lindbergh Beacon, the world's largest searchlight, at Chicago, Ill. Big enough to hold a man, this giant light is supported by a steel-and-aluminum tower designed to withstand a 100-mile-an-hour gale. Its 2,000,000,000-candlepower beam, at its source, is 20,000 times as bright as the sun as seen from the Earth.

A spectacular lighting effect achieved in New York City, a few years ago, proved *too* realistic. A midtown skyscraper had just been completed and the owners wanted something to attract attention to the building. With the help of a lighting expert, they worked out a spectacular night display. Jets in the tower of the building sent billows of steam rising into the air while colored lights, projected on the moving vapor, created the illusion of smoke and flame. The first night, sixteen fire alarms were turned in and the next day the Fire Commissioner called to ask that the display be discontinued!

These medium-sized spotlights use incandescent bulbs like the one the man is holding

New Kinks for Radio Experimenters

Mirror Makes Set Wiring Easier

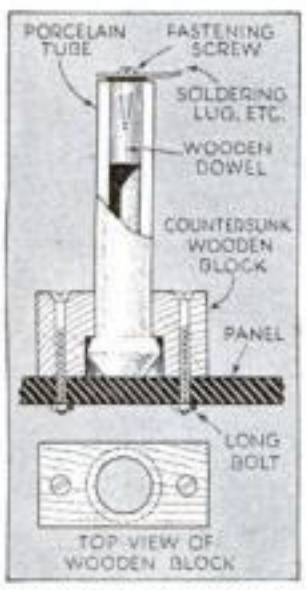
AN OLD mirror hung at the rear of your work bench will help to simplify your next set-wiring job. With it, the underside of the chassis will be in full view even when you are working on the top. Wires can be inserted easily through holes, and parts on the underside can be grasped readily. Incidentally, a neat test panel can be made up by installing the mirror in a wide frame and then arranging the necessary test meters, plugs, and switches around the sides.—W. W. K.

A Short-Wave Wiring Tip

FOR best results in wiring short-wave receivers, ground all parts of the circuit to a narrow brass strip mounted inside the chassis. This eliminates many of the losses that occur when each part is grounded individually to the chassis.

Stand-Off Insulators From Porcelain Tubes

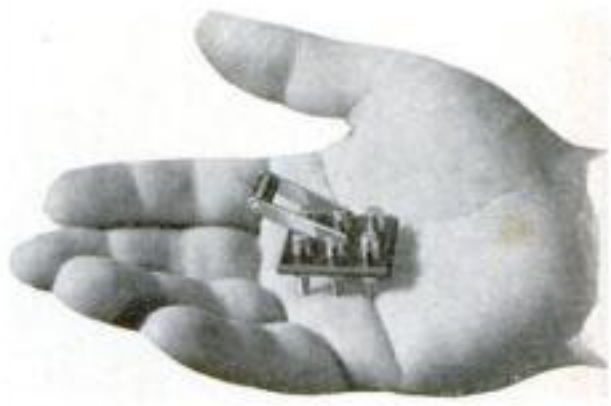
INEXPENSIVE stand-off insulators can be made from the ordinary porcelain tubes used in open house wiring. The large end of the tube is clamped to its support by a small, countersunk block of wood. A short section of wooden dowel then is forced into the tube, secured with shellac or cement, and a suitable screw is driven into its outer end. To avoid splitting the tube, a hole should be drilled in the end of the dowel before driving the screw. Almost any sort of soldering lug, binding post, or clamp may be fastened to the tube in this manner, and will be insulated from the supporting panel by several inches of porcelain. The resulting insulator will prove efficient.



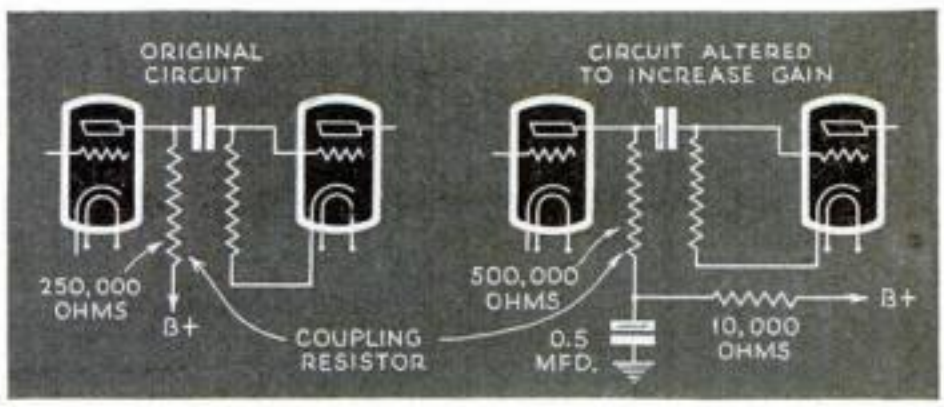
Drawing shows how the insulator is assembled

Midget Double-Throw Knife Switch

KNIFE switches are no novelty, but a double-pole, double-throw unit no larger than a postage stamp is something out of the ordinary. The one illustrated measures only one by one and one-quarter inch, yet it is a perfectly workable duplicate of the larger ones. Its compact size makes it useful as a speaker-earphone control inside of a small receiver cabinet, as a switching unit for portable tube and receiver testers, and in countless other places where space is at a premium. The diminutive size of the switch can be seen in the photograph above.



Tiny knife switch fits in the palm of the hand



Automatic Time Switch Turns Radio On or Off

WITH the latest in automatic timers you need never miss your favorite radio program and with a flip of its switch, you can transform your receiver into a new kind of alarm clock. Being small and supplied with a long connecting cord, this new time switch can be placed almost anywhere and a twist of its graduated dial is all that is necessary to put it in operation. It will turn the radio either on or off at any predetermined time up to ten hours. The photograph above shows the time switch and the connecting cord.

Increases Voltage Gain

BY MAKING use of a simple resistance-capacity filter, the voltage gain of any resistance-coupled amplifier usually can be increased considerably and oscillation completely eliminated. First, replace the usual 250,000-ohm plate coupling resistor with a 500,000-ohm unit. Then, in series with this larger resistor connect a 10,000-ohm unit and by-pass this to ground through a 0.5 mfd. fixed condenser. The condenser provides an easy ground return for the signal and eliminates all oscillation and coupling between stages.—E.B.L.

Long-Nosed Clip Helps In Difficult Test Jobs

PROVIDED with a long, slender snout, the "alligator" clip illustrated, is an improvement over the larger broad-nosed type for test work. Designed for use in hard-to-get-at places, its strong jaws will clamp tightly around even the smallest wire, while its broader rear portion makes it easy to hold. Alligator clips can be obtained plain or with an insulating overshoe.

New "alligator" clip with rubber insulation

ANYONE CAN BUILD THIS INEXPENSIVE Portable

The amplifier in use as a regular public-address system. The built-in speaker is behind the grille

BECAUSE it is compact and can be put to a wide variety of uses, the inexpensive portable public-address system illustrated is an ideal unit for the radio experimenter. Complete with loudspeaker, microphone, and power circuit, it weighs less than thirty pounds and can be constructed for less than the cost of a small receiver.

Wherever a good amplifier is needed, this multi-purpose unit will fill the bill. A series of input binding posts makes it possible to use it with almost any type of phonograph pick-up, microphone, or radio tuner. It can be used indoors or outdoors and will feed either the single dynamic speaker housed in its plywood cabinet or a series of speakers mounted at strategic points in a hall or building.

In many public-address systems, the use of various types of phonograph pick-ups often makes it necessary to resort to a complicated input circuit. With this unit, however, the four input binding posts solve the problem. A pick-up having an impedance of 200 ohms, for instance, can be connected directly across binding posts 3 and 4 without the need of an additional volume control. Pick-ups of the 500-ohm variety, on the other hand, can be used simply by connecting the two pick-up leads to terminals 2 and 4 and high-impedance pick-ups and crystal units can be used by making connections to binding posts 1 and 4.

The applications of microphones in public-address work are numerous. By proper connection to these same four binding posts almost any type of microphone now available can be used to feed this de luxe unit. Double-button microphone connections are made easily by wiring the three microphone leads to the binding posts 2, 3, and 4, bearing in mind that the battery for the microphone current must be connected in series with the lead to binding post 3 and that the connection at the binding post should be grounded. Single-button microphone connections are made simply by connecting the two microphone leads to binding posts 3 and 4, placing the battery in series with the lead attached to terminal 4. Velocity, ribbon, and dynamic microphones must, as usual, be used with pre-amplifiers having a 500-ohm or 200-ohm line-coupling transformer, which can be connected directly to binding posts 2 and 4 for 500 ohms and 3 and 4 for 200 ohms.

Often it is desirable to use a standard radio tuner in conjunction with a public-address system. To couple any type of radio tuner to this amplifier, simply connect the plate lead of the detector tube through a resistance and a .01 mfd. mica coupling condenser. The connections leading from the plate circuit of the tuner are made at the binding posts 1 and 4; the plate lead being attached to binding post 1 and the -B lead being connected to binding post 4.

PLATE and filament supplies can be taken from this multi-purpose circuit simply by changing the four-prong socket at the rear of the chassis to a seven-prong unit and making the proper B-voltage and filament connections to the socket.

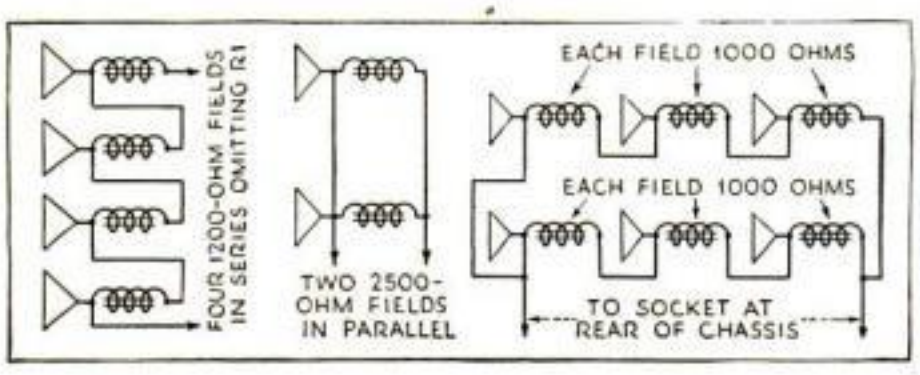
Multiple-speaker installations also are very often required in public-address systems, especially in hospitals, department stores, and market places, where a large area is to be covered by the amplified sound. How multiple-speaker systems can be used is clearly shown in the diagrams.

In the building of this amplifier, it is important that the diagrams and specifications be followed closely, especially the layout of the transformers and tubes. These have been carefully placed to minimize all possible stray magnetic fields and eliminate unwanted input hum. A great deal of thought also has been given to the proper selection of tubes for efficiency, quality, and distortionless operation.

All parts required for the construction are simple, inexpensive, and easily obtained. There are but four transformers and one B-filter choke needed. For best results, it is advisable to use a high-quality input transformer to avoid the loss of high-frequency response. The second transformer, a class "A-prime" input push-pull unit, should be of the type designed for use with a type '42 tube, triode connected. If you have difficulty in obtaining

MORE SPEAKERS

Additional speakers may be used, if the one in the cabinet is not sufficient. They are connected as shown at the right, through a speaker plug at the side of the chassis. Diagram below shows the speaker hook-ups



Public-Address System

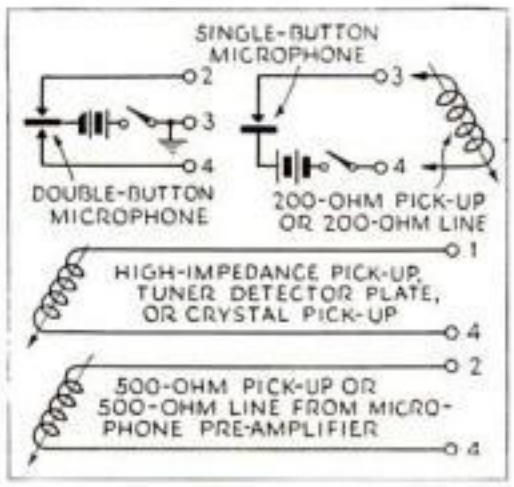
By WALTER J. BRONSON

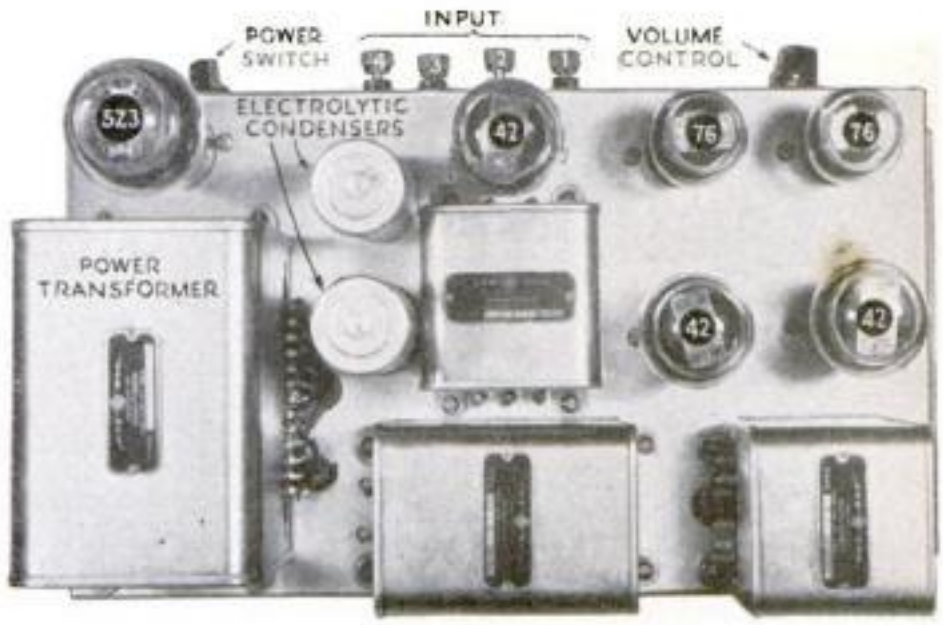
•

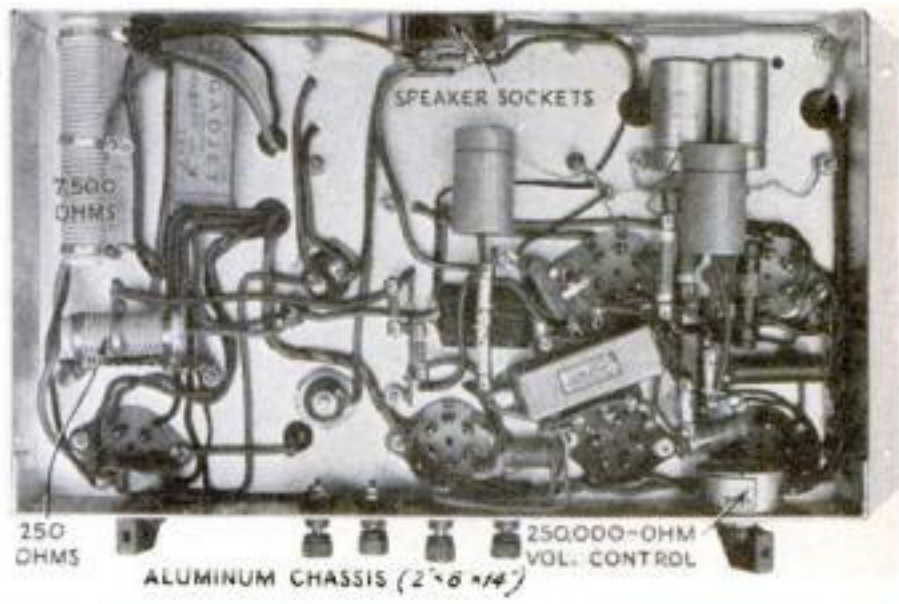
a transformer designed for triode '42's, a class "B" input push-pull unit can be substituted.

A high-quality push-pull output transformer also must be used if satisfactory results are to be expected. The transformer used on the original has several taps for a variety of speaker combinations to be used with multiple speaker systems. The windings are for 4-, 8-, and 15-ohm voice coils. It also has a 500-ohm output line for recording purposes and multiple-speaker systems employing a 500-ohm line transformer to the voice coil.

In cases where only a single speaker is used, the output transformer already mounted on the speaker frame can serve. If this transformer is for a push-pull triode, the connections are made according to the solid lines shown in the schematic diagram. On the other hand, if the output transformer is for pentode output tubes, the connections are made where the dotted lines are shown.

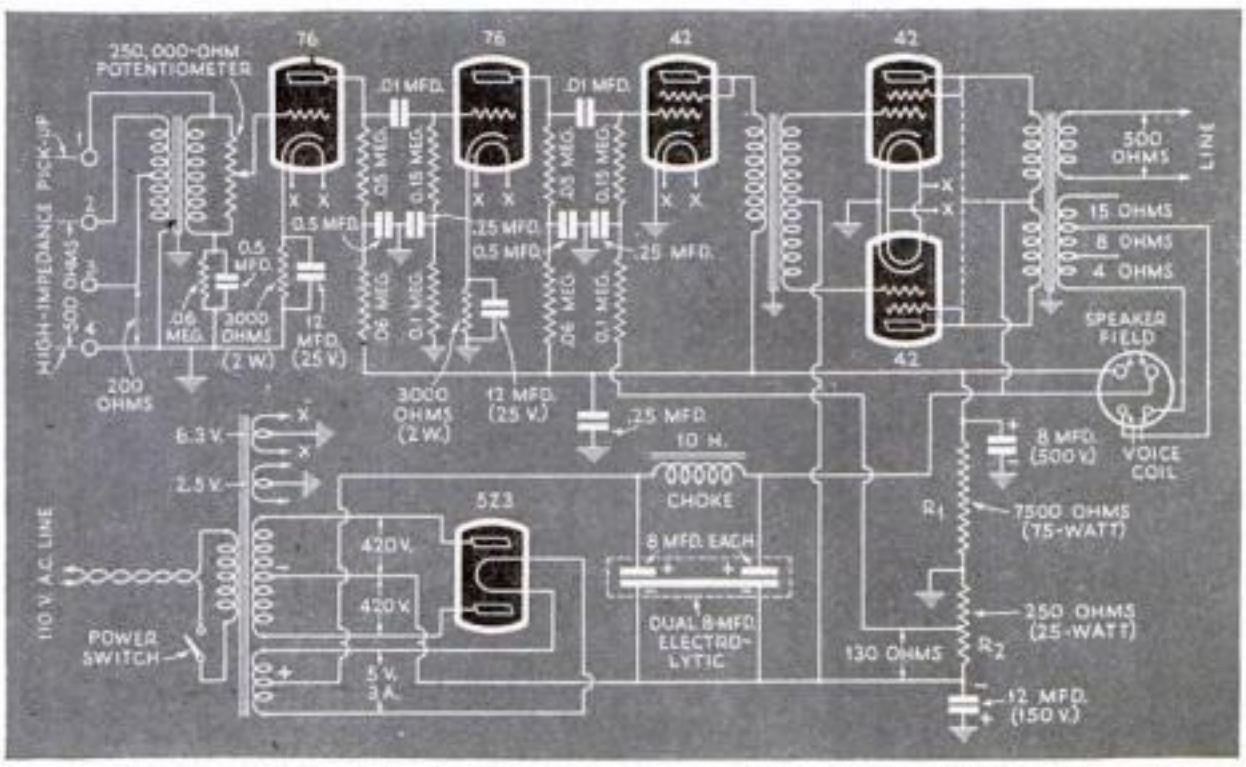






Top and bottom views of the chassis removed from the cabinet. In the latter, resistors and condensers are shown. Note input binding posts

Photo and diagram at left show how phonograph pick-ups can be connected into the amplifier. The author is seen adjusting the volume control knob



Schematic diagram with specifications for parts. Filament wiring is indicated by the references "X"

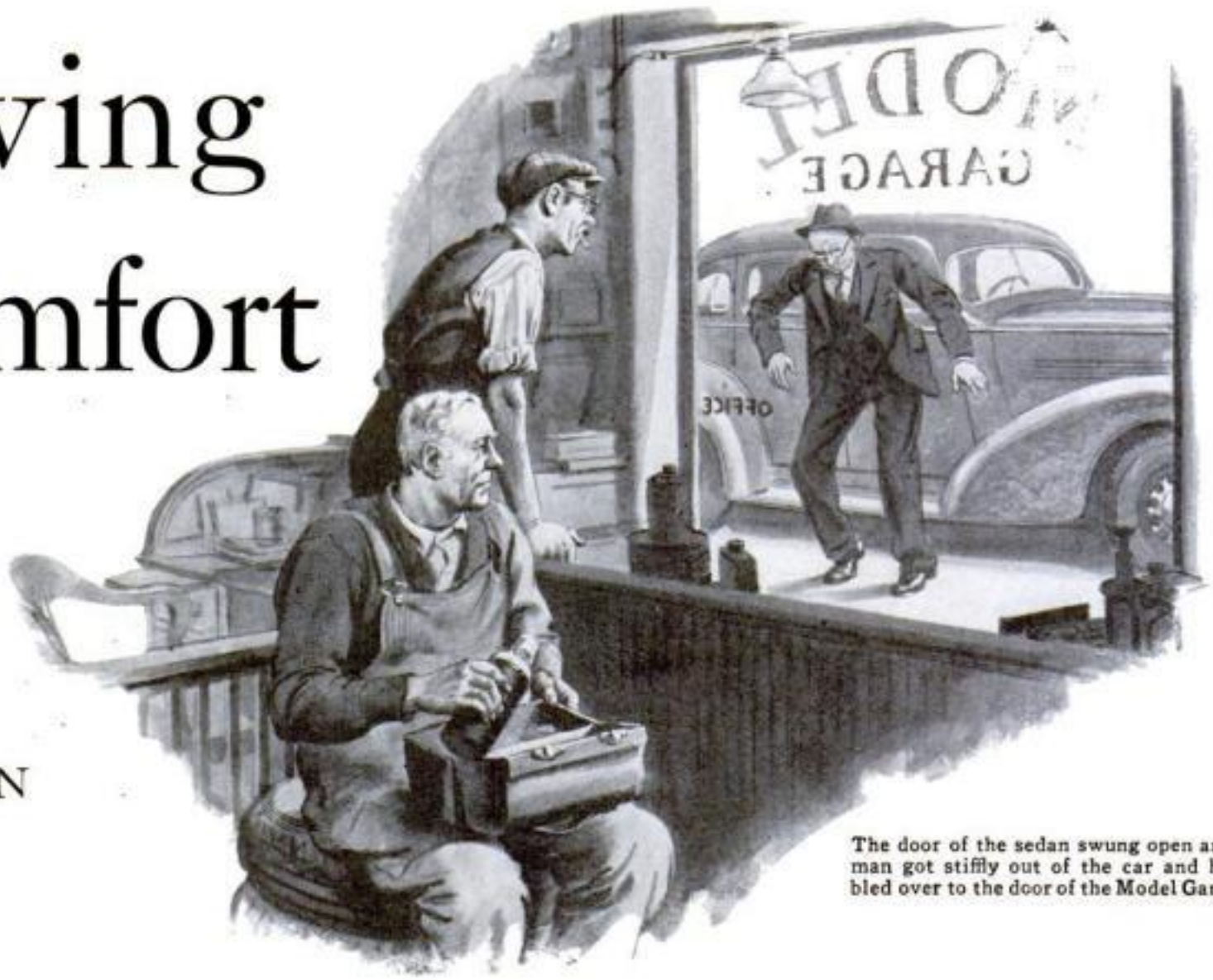
The power transformer should have a current-carrying capacity of 150 milliamperes with good regulation, as the tubes and bleeder resistor in the circuit draw 120 milliamperes. If the filament supply is to serve the additional tubes in a broadcast or short-wave tuner, the 6.3-volt filament winding should be heavy enough to carry at least nine or ten tubes. On the power transformer used in this original unit, a 2.5-volt filament winding, having a current-carrying capacity of fourteen amperes, also is included to take care of tuners having 2.5-volt filament supplies. The rectifier filament winding is for five volts with a current rating of three amperes.

As indicated, capacity input is used in the power-filter network to insure good voltage regulation. The three 8-mfd. electrolytic condensers are more than sufficient for excellent filtering throughout the B circuit. Since but one filter choke is used, however, it should be a high-grade unit rated at ten henries inductance or more, and be capable *(Continued on page 106)*

TRICKS THAT ADD TO . . .

Driving Comfort

By MARTIN BUNN



The door of the sedan swung open and a man got stiffly out of the car and hobbled over to the door of the Model Garage

"THERE'S a fellow who's been places and done things," observed Joe Clark to his partner, Gus Wilson, as he watched a dusty, mud-spattered sedan pull up in front of the Model Garage.

Gus stuffed the last of a ham sandwich into his mouth and fished a vacuum bottle of coffee out of his lunch kit as he strolled over to the window.

"That baby's been traveling off the main routes a long way from here," he said, as he eyed the sedan. "There's no mud just that color anywhere around these parts. And look how it's caked into the spokes. Well, I'll be jiggered! If it isn't O'Hara with a new car!"

"So it is," echoed Joe, as the door of the sedan swung open and a red-headed man got stiffly out of the car and hobbled over to the door of the little office of the Model Garage.

"A bit cramped after a long trip, Mr. O'Hara?" Gus inquired.

"I'll say I am," grunted O'Hara. "Let me sit down and rest a minute."

Gus pushed forward a chair and the red-headed motorist sank into it with a grateful sigh. "What I can't understand," he observed after a moment, "is why this hard chair seems so comfortable. I almost hate to think of getting back in the car. It cramps me just as bad as any of the old ones. I've been on the road all day and I still have one more call to make."

"Driving that new car ought to be like sitting on a sofa," said Gus. "Maybe one of the seat-cushion springs has come loose or the padding has shifted."

"No, it's not that. Everything is fine and comfortable when I start out, but I'm always all cramped and tired by the time I get to the end of a long run. And it's not that the driving position is uncomfortable. That's fine, too. Every car I've had, it's been the same way. Other fellows don't seem to get so tired. Maybe it's just that I'm getting old and can't take it any more!"

"Old!" exclaimed the veteran auto mechanic. "Wait till you're my age, young fellow, before you talk that way. Of course, some people tire more easily than others without counting age at all. And what tires one man may not tire another. But your trouble, I'll bet five gallons of gas, is that you really don't know how to drive a car!"

"Quit your kidding," snorted O'Hara. "I'm on the road all the time, and I've driven at least a couple of hundred thousand miles."

"Sure you have," Gus agreed, "but you ought to be able to drive without getting tired. Learning how to do any job means learning how to do it easily. It's the easy part you haven't got the hang of, yet."

"You mean I put too much beef into moving the gear shift—things like that?"

"Not a bit of it," said Gus. "You knew all that stuff a hundred thousand miles ago. But, is your driving position really comfortable? You say it is, but are you sure? Have you tried moving the seat back and forth to different distances from the pedals? I'll bet you've done what most drivers do. You adjusted the seat, when you first got the new bus, so that you could reach the pedals without having to stretch. You never thought that the position that seems most comfortable when you just climb in and try it for a second or two, may not be right for long trips.

"Another thing," Gus continued. "Are you sure that the seat itself fits you? You wouldn't expect every ready-made suit you tried on to fit you exactly right. Why should a ready-made car seat fit you unless you happen to be exactly average in measurements? Perhaps the back seat cushion is not at the best angle to support your back. Possibly the seat-cushion springs are too stiff or too weak for your weight.

"I once knew a tire salesman who spent most of his waking hours pounding the road in a car. He was a skinny, wiry little chap, the kind you'd think would want all the upholstery he could get to take the place of the natural padding he didn't have. And yet, the first thing he did when he got a new car was to rip out the driver's seat-cushion and put in a thin, springless, leather cushion. He claimed that bouncing around on top of a bunch of springs tired him more than riding on the hard seat."

"I'd prefer springs," O'Hara commented.

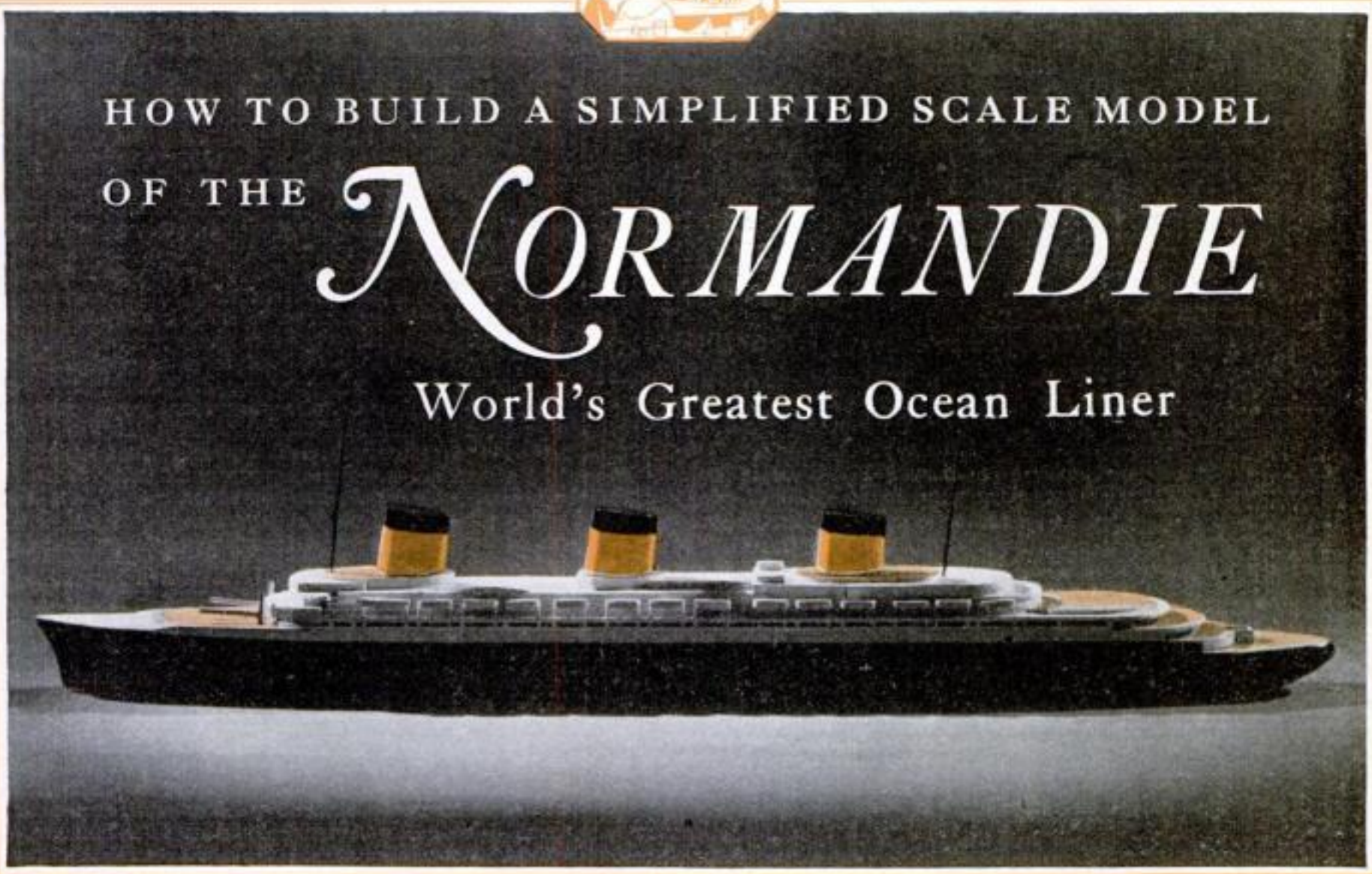
"So do I, (Continued on page 106)

Gus says:

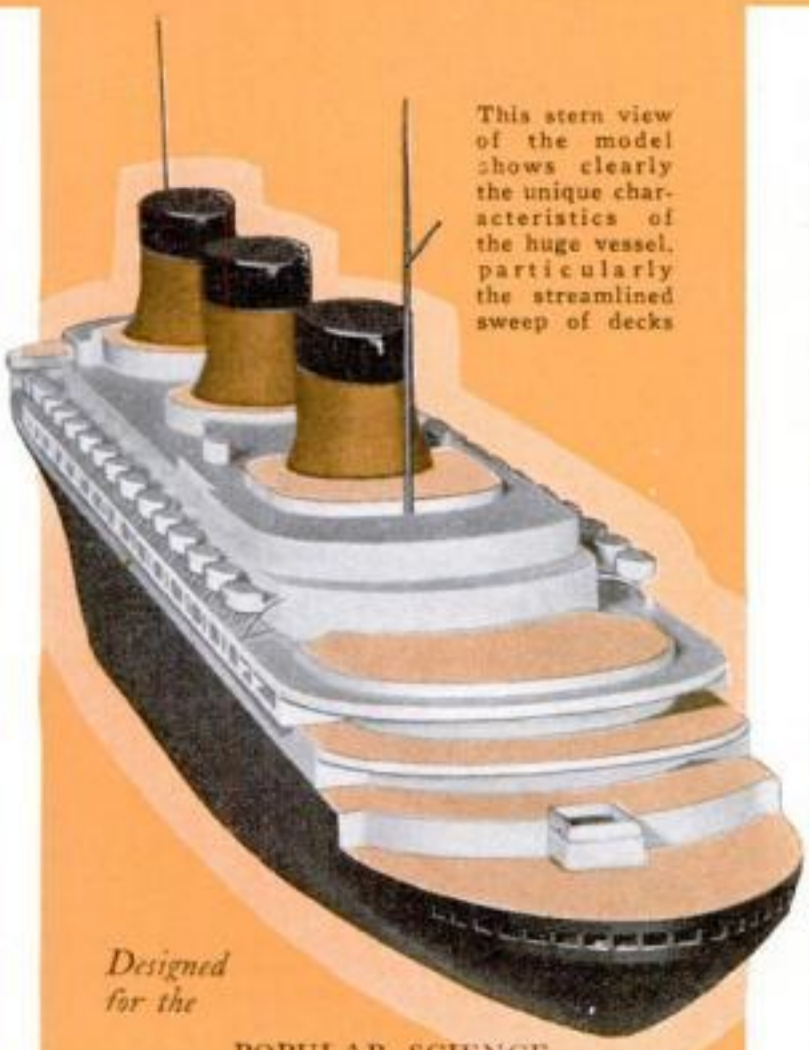
Four-wheel brakes will stop a car quicker than the old two-wheel style, but they aren't so safe if you don't keep them in condition so that all four are on the job. Let them go, and some day when you're depending on them for a quick stop, there'll be a gosh-awful crash that will make brake-repair cost look like buying a newspaper.

HOW TO BUILD A SIMPLIFIED SCALE MODEL OF THE *NORMANDIE*

World's Greatest Ocean Liner



You can judge from this photograph how realistic our new model of the *Normandie* is. The over-all length of the model is 20½ in.



This stern view of the model shows clearly the unique characteristics of the huge vessel, particularly the streamlined sweep of decks

Designed for the

POPULAR SCIENCE MODEL-OF-THE-MONTH CLUB

By Theodore Gommi

BY THE time this issue reaches the news stands, the gigantic new French liner *Normandie* is scheduled to be halfway across the Atlantic on her maiden voyage. She is expected to break records and set the blue ribbon of the Atlantic flying alongside the French tricolor for the first time in history. Those who actually see her, however, will marvel most at her tremendous size. Over 1,000 ft. long and with a gross tonnage of 79,280, she is by far the largest ship afloat—in fact, the largest single moving unit in the history of the world.

The Popular Science Model-of-the-Month Club is fortunate to have plans for an authentic scale model of this ship at so early a date. Thanks are due Clayland T. Morgan, of the French Line, through whom the writer received the finally revised plans of the *Normandie* from her builders in France. These have been reduced to the scale of 1 in. equals 50 ft. to conform with the majority of the other ships in the Model-of-the-Month Club series.

For so small a scale, the model is reasonably complete. This is largely due to a unique characteristic in the *Normandie's* design. The streamlined sweep of her decks is unbroken by ventilators and other fittings. Even the bow, usually crowded with anchor chains and cargo winches, is smoothly covered by a whaleback deck that accentuates the graceful sheer of the hull. Because the superstructure, as we shall see later, requires rather heavy construction, it was thought advisable to make the model out of white pine or basswood. Balsa, however, is quite satisfactory and more easily cut. It has the advantage, too, of being stocked in many thicknesses by model airplane dealers.

To satisfy the wishes of those readers who prefer full-hull models, the underwater profiles have been shown in the drawings. The wings supporting the four screws, however, have been omitted for the sake of clarity in the remainder of the drawing. These wings, similar to those of any quadruple-screw ship, may be wood or a plastic wood composition (see P.S.M., Nov. '33, p. 16). The screws have three blades each. In constructing a full-hull model, it will be necessary merely to use a piece 1 in. instead of ¼ in. thick for piece *A*, and to cut templates as shown in the drawings for guides in shaping.

All the parts can be cut from the material specified in the list at the

end of the article. It is advisable to cut and shape the larger pieces, and make up the smaller ones from the remaining scraps. Also, before cutting down to exact length a piece having an end that is shaped or curved, it is better to shape the end, and then measure and cut to length. The hull proper (parts *A*, *B*, *C*, *D*) may be carved from a single solid block, if preferred.

Aside from the funnels and other fittings, the model is divided into two parts, the hull and the superstructure, which are to be completed separately and glued together after painting. The hull in turn is divided into the four "black" decks, *A*, *B*, *C*, and *D*, and one "white" deck *E*. While the first four may therefore be fastened together with glue before shaping the hull, piece *E* should be fastened to *D* with light nails. After the hull is completely shaped, piece *E* must be removed to be painted white on the edges and buff on top at each end.

Before shaping the hull, draw the contour lines shown in Fig. 2 on piece *E* at the bow and piece *B* at the stern. On the underside of piece *A*, trace the contour lines at the water line, as shown in the diagram on the same plate. Cut away the excess wood to these lines, preserving, however, the shape both at water line and deck as first drawn. The sloping sides of the hull fore and aft will result. Now shape the flare forward, using the cross-section diagram as a guide. The curved bow will automatically result, and it can be trimmed to the exact profile. Trace also on *E* the exact location of the forward edge of the breakwater *(M)*. From this line forward, whittle down the sides of the deck towards the edges until the whaleback, clearly shown in the cross-section diagram, is formed. With a small chisel, cut out the anchor housings. Piece *E* may now be removed from the others and set aside while the rest of the hull is completed.

Shape *F*, *G*, and *H*, and fasten to *B* in the pocket already formed at the stern. With sandpaper, bevel the edge at the very stern, so that the top of *H* is shaped as shown by the dotted line in the detail of that part. Shape *I* and *J*, and fasten in place. Fit four small pieces of half-split reed around the edges of *J* to make the swimming pool.

Cut out *K*, *L*, and *M*, and fasten to piece *E*. Sandpaper the joint of *L* and *E* so that the deck is smooth. Sandpaper the legs of *M* until they gradually slope into the line of the deck. Make the two derricks from 1/16-in. round wood and insert into *E* after drilling holes in the proper locations.

Cut three anchors out of thin card and fasten two at the sides and one across the bow, all at the same level. A better appearance may result in the model, however, if the bow anchor is omitted, since it is difficult to fasten it neatly on so small a surface.

To proceed with the construction of the superstructure, shape all the pieces shown in Fig. 3. You will notice that many are identical and can be cut and shaped at the same time. Also, *N* and *P* are alike, except that in fastening them to O, the rounded edge of *N* is fore, and that of *P* is aft, while *P* is uppermost. After *P* is fastened to *O*, small holes should be drilled into *P* directly over the projections of *O*, as shown.

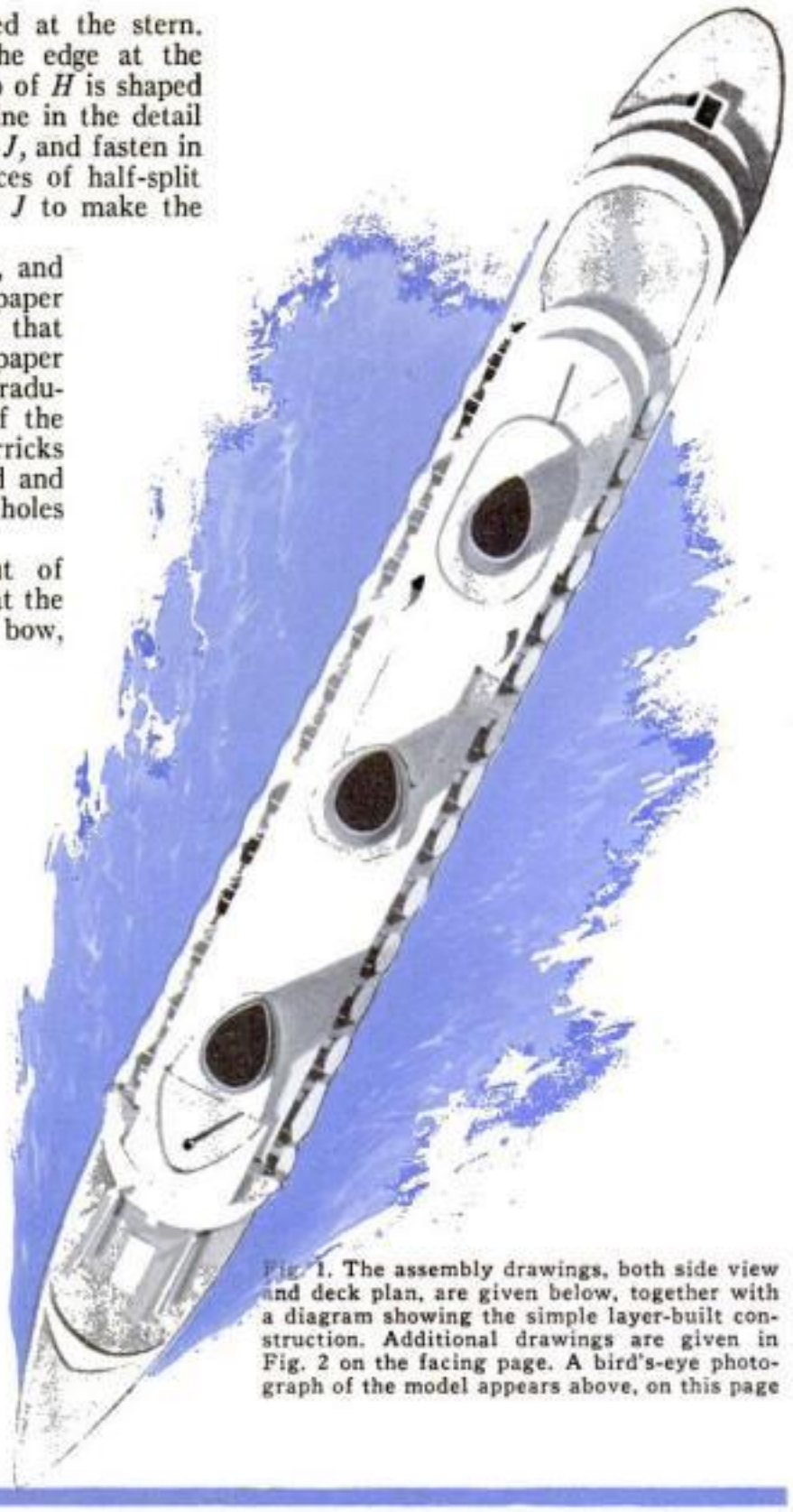
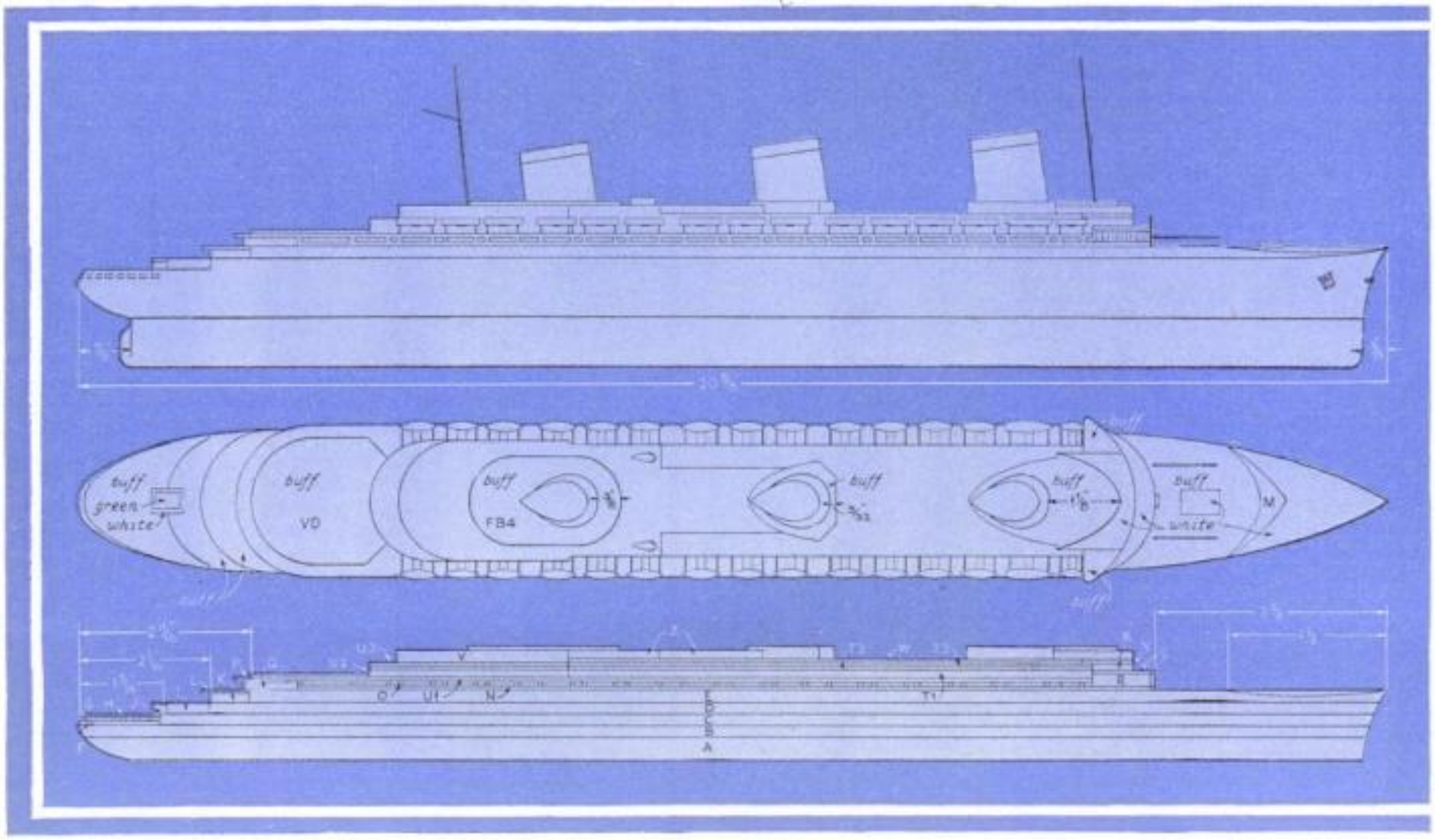
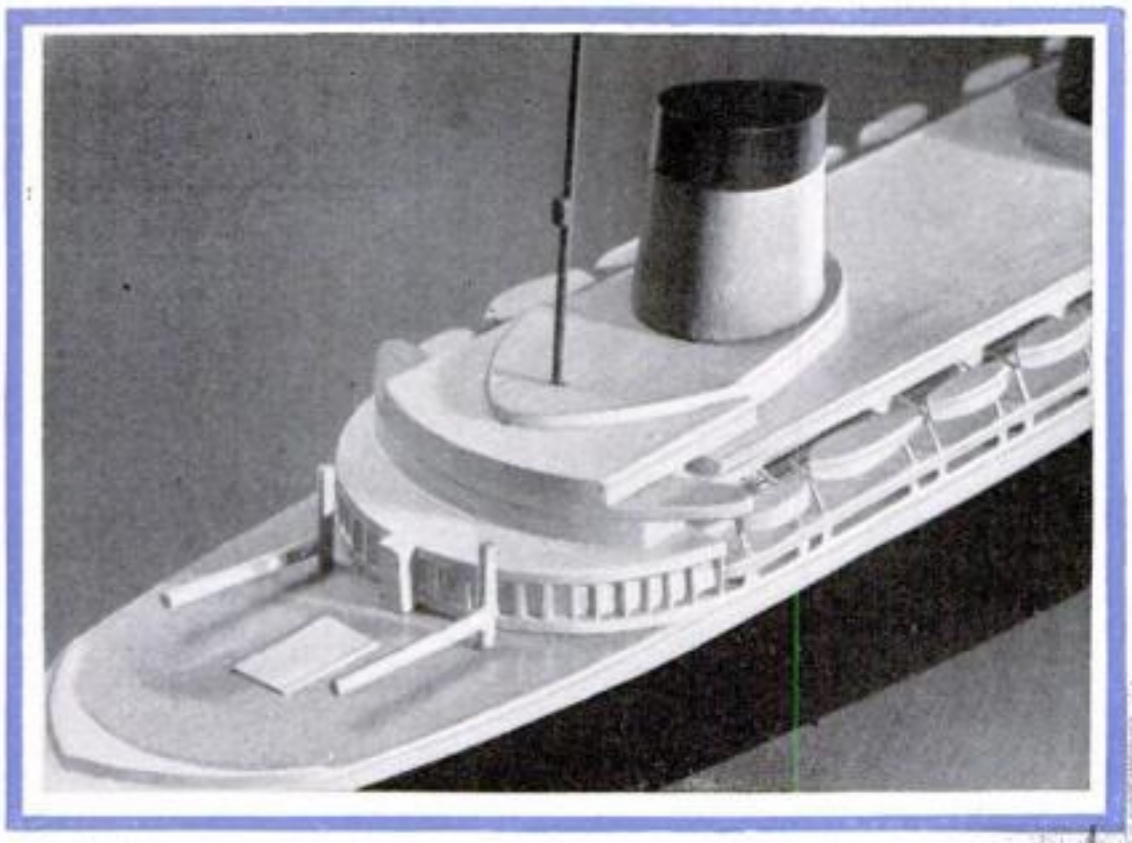


Fig. 1. The assembly drawings, both side view and deck plan, are given below, together with a diagram showing the simple layer-built construction. Additional drawings are given in Fig. 2 on the facing page. A bird's-eye photograph of the model appears above, on this page



Turn to page 78 for classified list of blueprints.



The detail photograph at the left shows the forward part of the superstructure, the foremast, and the forward funnel. Note the arrangement of the lifeboats. To simplify painting problems and insure a clean-cut job, hull units and superstructure are painted separately before assembling the model

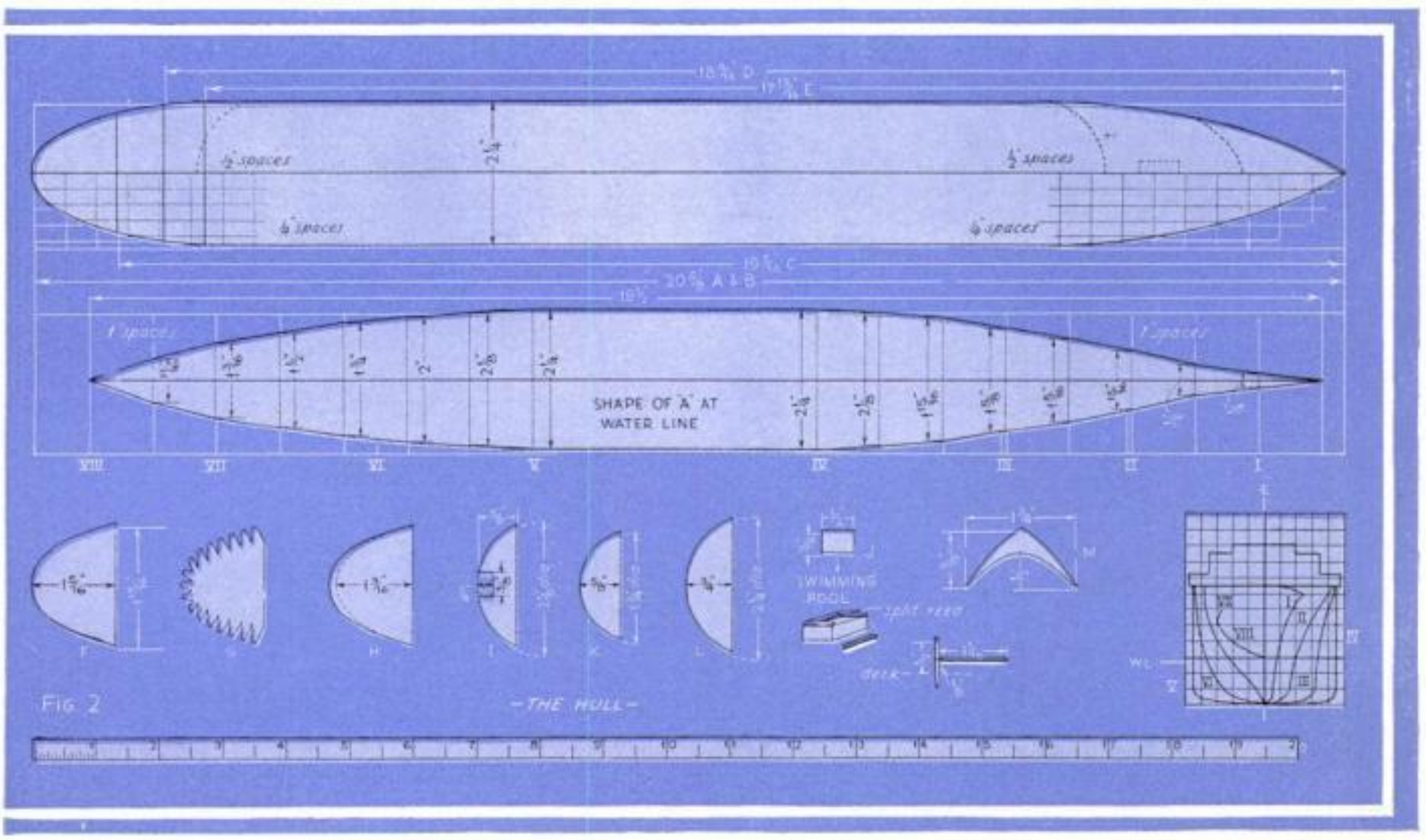
Fasten *R* to *N* and *S* to *R*. Since *R* has a slightly shorter radius, the edges of *N* and *S* will extend beyond *R*. In the little groove thus formed, insert short 3/16-in. pieces of split bamboo to give the effect of large windows. Fasten *Q* to the underside of *P*.

The next few steps are the ones requiring the greatest care. Glue U^1 and T^1 to *P*. Across these two pieces, glue the fifteen paper strips shown by dotted lines in the plans; they are to hold the lifeboats. Fasten U^2 and T^2 to U^1 and T^1, and be certain that the paper strips remain in position until the glue hardens. Cut thin wire into pieces about ¾ in. long. Into each of the holes drilled in *P*, insert one of these short wires. Carefully bend the wires until they touch the edge of T^2 and U^2. Bend down the remainder of each wire until it is flat against the top of these pieces. Figure 5 illustrates this clearly. Now fasten T^3 and U^3 to T^2 and U^2, using plenty of glue and thin brads, so that the ends of the wires are tightly held in place.

Glue *V*, *W*, *X*, and *Y* in place. *V* and *W* join directly over the juncture of *T* and *U*.

Cut to shape the seven top-deck housings shown in Fig. 4. Note that piece FB^3 fits snugly into *Z*; also that *VD* fits snugly around the end of *V*. Fasten all to the superstructure as indicated in the side elevation and plan on opposite page.

Make the two streamlined ventilators and the lifeboats as shown in Fig. 5. There are three sizes of lifeboats, twenty-six being 5/8 in. long; two, ½ in. long; and two, which are actually motor launches, ¾ in. long. The twenty-six that are all alike can best be made by rounding the edges of the 5/32 by 5/8 in. stick to the shape indicated, and then cutting or sawing crosswise, as if slicing bread, at 1/8-in. intervals. This stick can *(Continued on page 76)*



Right: The fly has a turned wooden body, celluloid wings, bead eyes, and wire legs

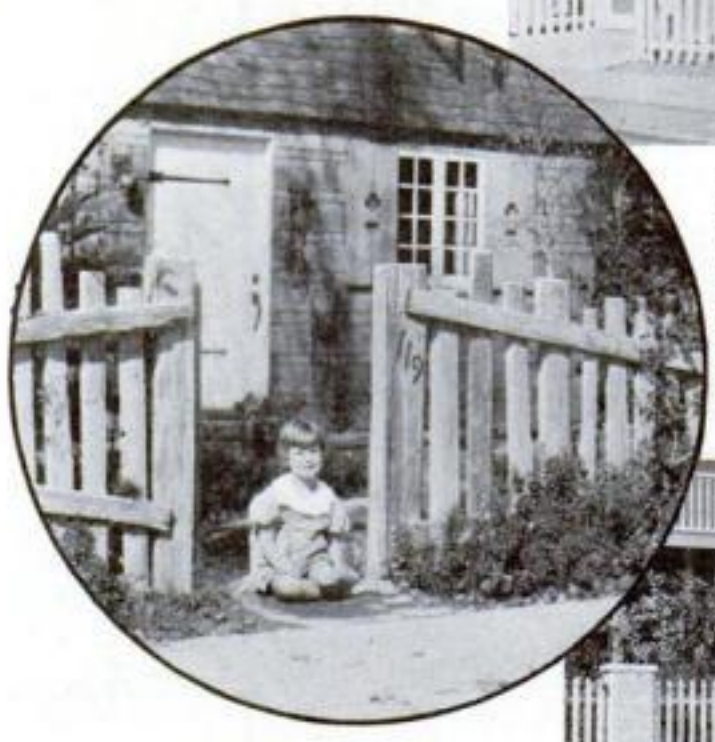
Above: Cork with life-ring ornament. *At right:* Stopper with clown's head. The head is first turned, then the collar is shaped with a small grinder as shown below

TURNED ORNAMENTS FOR BOTTLE STOPPERS

ATTRACTIVE and ornamental bottle stoppers such as those illustrated above can be easily turned on the lathe and then attached with waterproof casein glue to size No. 7 or No. 8 corks.

The clown figure was first turned to shape; then the wavy collar was formed by means of a hand grinding tool, as shown in one of the photographs. The realistic fly at the top of the column is a small wood turning, with celluloid wings, bead eyes, and wire legs added. The life-saver's ring was turned separately from the base and the two then glued together. All sorts of amusing names can be lettered on such rings, if desired. Use quick-drying enamel, rather than lacquer, for finishing and ornamenting.

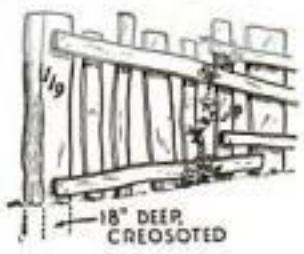
ONE OF THESE fences WILL IMPROVE YOUR PROPERTY



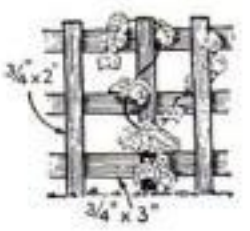
A pleasing variation of the ordinary picket fence is obtained by the use of crooked boards for the uprights

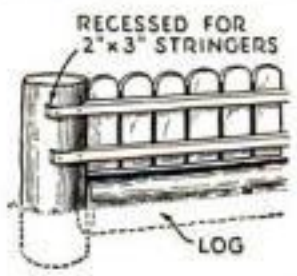
A simple picket fence with substantial brick supports. Such a fence is at home with any Colonial design. If wooden posts are used, treat the lower ends liberally with creosote

Almost any wood of odd sizes can be used for constructing a picturesque fence of this type. It surrounds a cottage on Balboa Island, Calif.

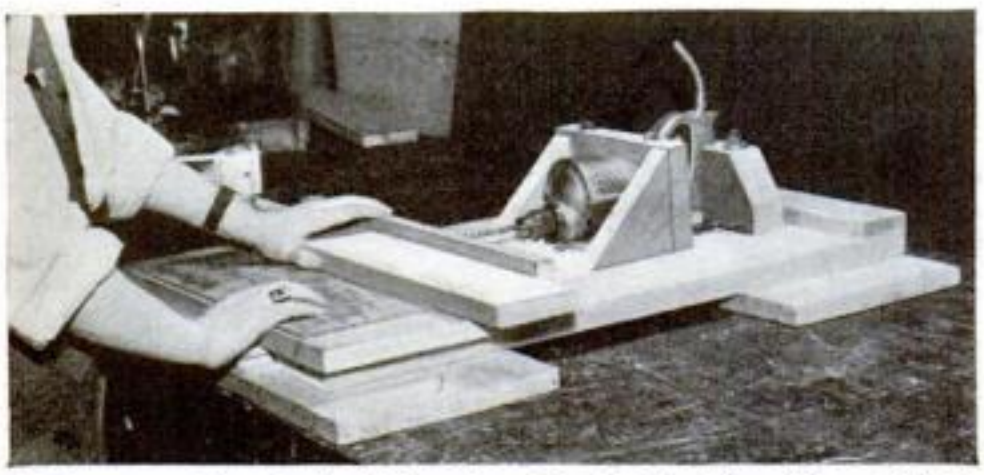


A low lattice fence is shown below, and the dimensions are indicated at the right. In this case, it acts as a trellis for English ivy, only the tops of the pickets and posts being seen





Sections cut from old telephone poles form the supports for this fence. The fence boards are of rough pine, weathered. Note the half-buried log

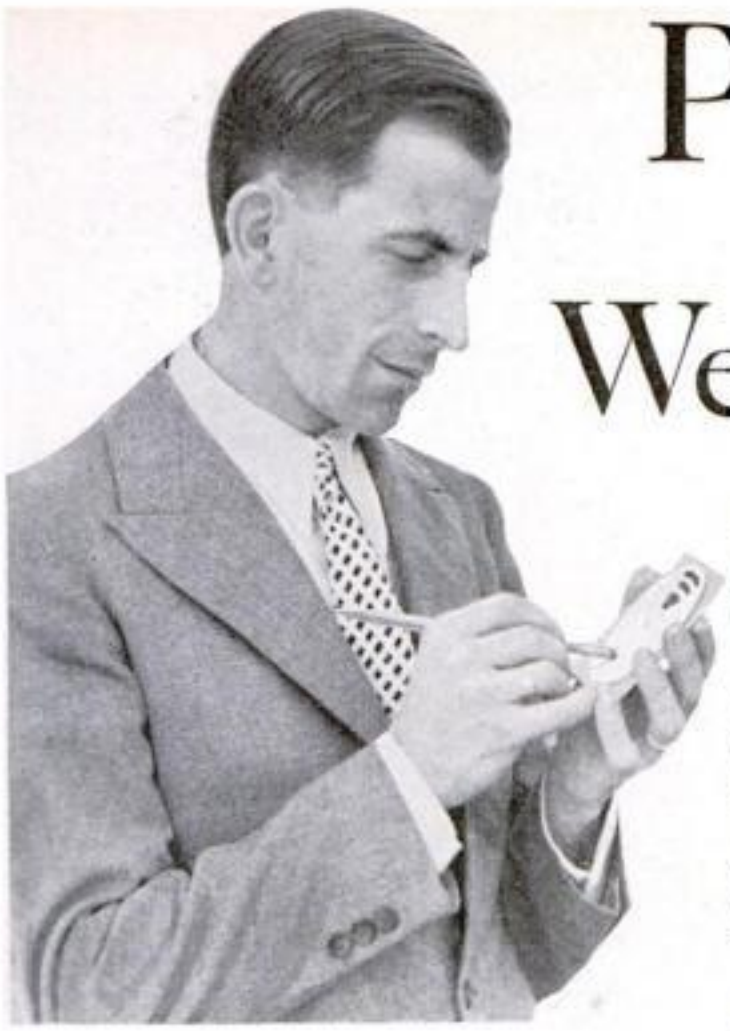


Using a portable electric drill to bore dowel holes. The sliding table is designed for stock 1⅛ in. thick; anything thinner must be blocked up

SLIDING DOWEL-HOLE JIG

ALTHOUGH easily constructed, this jig and sliding table for a portable electric drill proves a great timesaver over usual methods of doweling. Accuracy is insured by centering the marked stock in relation to the table.

The fixed part of the device consists of a solid platform 9½-in. wide with grooved edges. The drill is held in place on the platform by a backpiece fitted to the handle and a split yoke for the drill body. The sliding rails are made from two 4-in. pieces tongued on one edge and fitted in the grooves of the solid platform. A 3-in. crosspiece holds the rails in place. The work-holding table is 10 by 20 in. and has a 2-in. piece fastened to the front edge. This table is mounted on the sliding rails.—M. J. MCCONNELL.



Pocket Chart Aids in Local Weather Forecasting

By Edwin M. Love

VACATION time is at hand. The weather is fairly settled, yet it may act up unexpectedly and make us change our plans. Shall we sleep in the open on our trip, or shall we patronize an automobile camp or a hotel? Which will offer the fairest skies, the beach or the mountains?

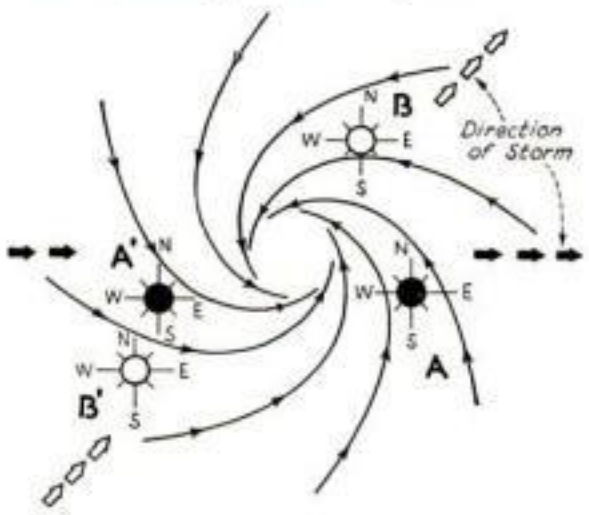
While all sections of the United States are now reached daily by broadcasts of weather information, there is a good deal of satisfaction in reading the face of the sky for yourself, and predicting local weather conditions several hours in advance. If you have a barometer, you can become a skillful prophet by observing that instrument and the wind direction, and by jotting down daily notes on your conclusions. Once in a while you may even make a more accurate forecast than the professionals.

Foul-weather signs naturally result from the build of the storm. When brisk southeasterly winds set in and clouds darken the sky, it is natural to suppose that the threatening storm blew up from the southeast, but this is not the case. It came from the west or northwest, and its center will pass near or north of you, with the wind shifting to northwest by way of south and southwest. If you had noticed, at the beginning of the breeze, that the barometer was falling, you could safely have predicted rain within from twelve to twenty-four hours.

If the wind sets in east to northeast, the storm is coming from the south or southwest, and its center will pass near or to the south, with the wind shifting to northwest by way of north. The rapidity of the storm's approach and its intensity can be judged by the rate and the amount of fall in the barometer.

To visualize the make-up of a storm area —cyclone, weather men call it—suppose that a large airplane propeller mounted horizontally on a rolling carriage is whirling counter clockwise. There is an upward movement of air; and if you should walk around the propeller carrying a vane, you would find that the surrounding air spiraled in toward the center, the direction of the "wind" depending entirely on where you are with relation to the propeller. If the latter were moved from west to east, or from southwest to northeast, while you stood still, the direction of the wind would shift as it does when a storm goes by.

A storm is roughly circular in shape, with a warm, light, moisture-laden core of air rising at the center, and the wind sweeping in spirally from all sides. As the core rises to the thinner upper air it expands; expanding, it cools, just as air from a leaking automobile tire valve rushes out in a cold jet. Before long, the temperature is so low that moisture condenses on the floating dust particles, and clouds are seen. Presently, further expansion loads the damp particles so heavily with water that the upward draft can no longer support them, and they fall as rain. The whole storm system moves across the country at a speed in summer of about 25 M.P.H., and in winter, 35.



As this storm comes from the west, an observer at *A* finds the barometer falling and the wind blowing from the southeast. As its center passes north of him, the wind veers to south, southwest, and west, finally setting in from the northwest as at A^1. Compare the observations at *B* and B^1

The cool, expanded air, unable to rise higher, and freed of its moisture, is thrust aside by the warmer rising core air and circulates to other localities beyond the storm, where it settles to earth again. This is the reverse of the movement in the storm area, and the winds blow outward from these downward columns in a spiral of clockwise motion. This reverse system, the anticyclone, follows the cyclone, sometimes closely, sometimes at quite a distance.

This explains why air pressure lowers as a storm approaches, and rises again as foul weather recedes and the anticyclone comes along.

The accompanying diagram shows a cyclonic area. Note that an observer at *B*, finding the direction of the wind to be from the northeast, can expect the storm from the southwest, with the wind swinging to north and northwest as the center of the storm passes to the south.

The United States Weather Bureau has worked out some forecasting rules that apply in general to this country, and these are conveniently grouped in the chart on page 85. The assembling of this chart is a simple task that can be done in a few moments of time, and the resulting pocket weather clock is very handy for local forecasting.

Lay out the two dials and paste them on cardboard, trimming the mount to shape when dry. With a sharp-pointed knife, cut out the windows in the front disk, push a pin through the centers for a pivot, and solder behind to a thin metal button. An eyelet or tubular rivet would make a more durable bearing. Paste the forecasts on the *(Continued on page 85)*

The two disks can be any convenient size. The author made the outer circle 4 in. in diameter. The key numbers *1* to *16* on the three inner circles refer to the forecasts listed on page 85

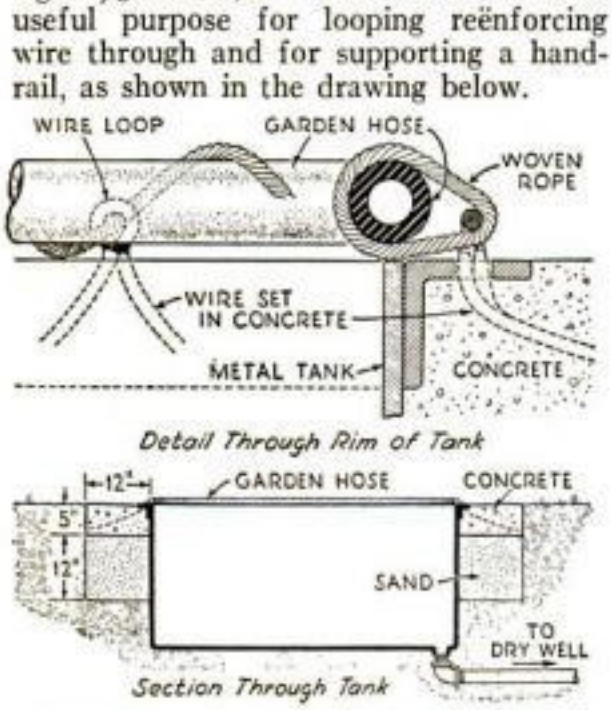
Garden Pool Made Cheaply from Old Tank

A DISCARDED tank that was rusting away in a junk yard was reclaimed to make this attractive garden plunge. It was far less expensive than constructing a concrete one, as it cost but $7 and was transported on the rear bumper of a car.

There are all sorts of shapes and sizes of tanks obtainable. The shallow rectangular tank used for mixing mortar is an ideal size for a child's wading pool. There are also round tanks once used as stills, and square or long rectangular storage tanks from the attics of torn-down buildings.

If a tank is too deep, the bottom may be filled with sand. This would make it adaptable for an outdoor aquarium as well as for aquatic plants.

For our purpose a round tank was selected, 5 ft. in diameter and 27 in. deep. It had two holes in the side, but these were welded shut at the junk yard. Most of these dealers have welding outfits. The bottom of the tank had a hole threaded for a 2½-in. pipe, so this determined the size of the drain pipe. The open top of the tank had an angle iron ring with forty-eight ⅜-in. holes. These holes served a useful purpose for looping reënforcing wire through and for supporting a hand-rail, as shown in the drawing below.



How the tank is set in place and method of fastening a garden hose around the metal rim

A ⅝-in. green-colored garden hose, coupled end to end, became the grab rail. It was attached by weaving ¼-in. rope around the hose and through the wire loops just mentioned. This raised the rubber hose ¼-in. above the ring of the tank so that surface film could wash under it and over the surrounding cement walk to the lawn.

The bottom of the tank excavation was leveled with sand, and after the outside of the steel tank had been painted with black asphaltum paint, it was rolled on its side to the spot and then slid into the hole. Previously, however, the drain nipple and elbow were screwed in place and aimed at a trench leading to a dry well. The later was merely a deep hole filled with stones; it was dug about 10 ft. away. After the tank was in place, a length of 2½-in. pipe was screwed into the elbow connecting the pool and the dry well.

After experimenting with various types of drain stoppers, we found that a gum rubber handball was most satisfactory. To drain the tank, the ball is forced aside with a stick, whereupon it comes to the surface.

The tank was leveled by filling it with water to the rim. An automobile jack was then used to raise it while earth was rammed underneath. The earth was soaked thoroughly with water so that the tank became well imbedded. After this, a 12-in. wide trench was dug all around the tank and 12 in. of sand filled in. This was topped off with 5 in. of stone concrete, puddled with a stick to make it flush with, and sloping slightly away from, the metal rim. The outer edge of the concrete was held in place by packing the natural wet clay against a board 5 in. high and 12 in. long, the later being shifted progressively around the edge as soon as the clay had been well banked against it.

This decorative pool is 5 ft. in diameter and 27 in. deep. A child can swim a little in it, and an adult can do a trick "dive" into it

The inside of the tank was painted an azure blue. This serves the double purpose of presenting a smooth, washable surface from which to clean the inevitable algae and of giving a very clean-looking blue-green color to the water.

The pool is filled by a ½-in. garden hose in one hour and drained in ten minutes. It has been used by adults as well as children. Amusing as this may seem, it is just large enough for our newly devised adult "dive" in only 300 gal. of water. This is how it is done: Standing with feet at the edge and arching the body over, one grasps the roped edge of the pool about 4 ft. away and just falls sidewise, striking the water with the side of the arched body. This gives a complete and fairly exciting plunge. Another method of "diving" is to kneel on the edge and go in head first, there being sufficient depth to prevent one's striking the bottom. One may also float with knees bent slightly. The pool is just large enough to enable a child to swim about in a circle.—EDWIN A. KOCH.

When fastened to the carrier shown below, a kayak or other light craft is easily moved

BOX ON WHEELS CARRIES KAYAK TO WATER

TO CARRY a 14-ft. kayak from our house to a lake two blocks away, I use a small truck made as shown. It is merely an open box 11 by 11 by 18 in. mounted on the rear axle and two 10-in. wheels from an old velocipede. Handholes are cut in the ends of the box, and two trunk straps are fastened with screws across the top of the narrow ends. A cushion is placed on the box, and the kayak set on top of it and strapped down.

The axle is run through holes in the box in such a way that it can easily be removed. After the kayak has been launched, the wheels and axle are taken off and placed inside the box, which in turn is set in the cockpit, where is serves as a back rest for the bow paddler, as well as a receptacle for fish.—E. B. Fox.

MINIATURE MERRY-GO-ROUND MOUNTED ON AUTO AXLE

THIS small merry-go-round gives children no end of fun, yet is perfectly safe. The revolving platform is mounted on an old model-T Ford front axle and wheel assembly. The axle is sawed in half and set in concrete in the ground. Two pieces of 2 by 2 in. lumber are bolted to the wheel. The platform is then nailed to these crosspieces and sawed to a circular shape. One or more seats may be added for very small children, and a pipe handrail erected as shown for the use of older ones. —JOHN MAHER.

Skipper Sam'l

A QUAINT WOODEN FIGURE ANYONE CAN WHITTLE

Simple Step-by-Step Instructions

By E. J. TANGERMAN

You start with a block of softwood and shape it into a sort of mechanical man (at right). The subsequent cuts are almost equally easy

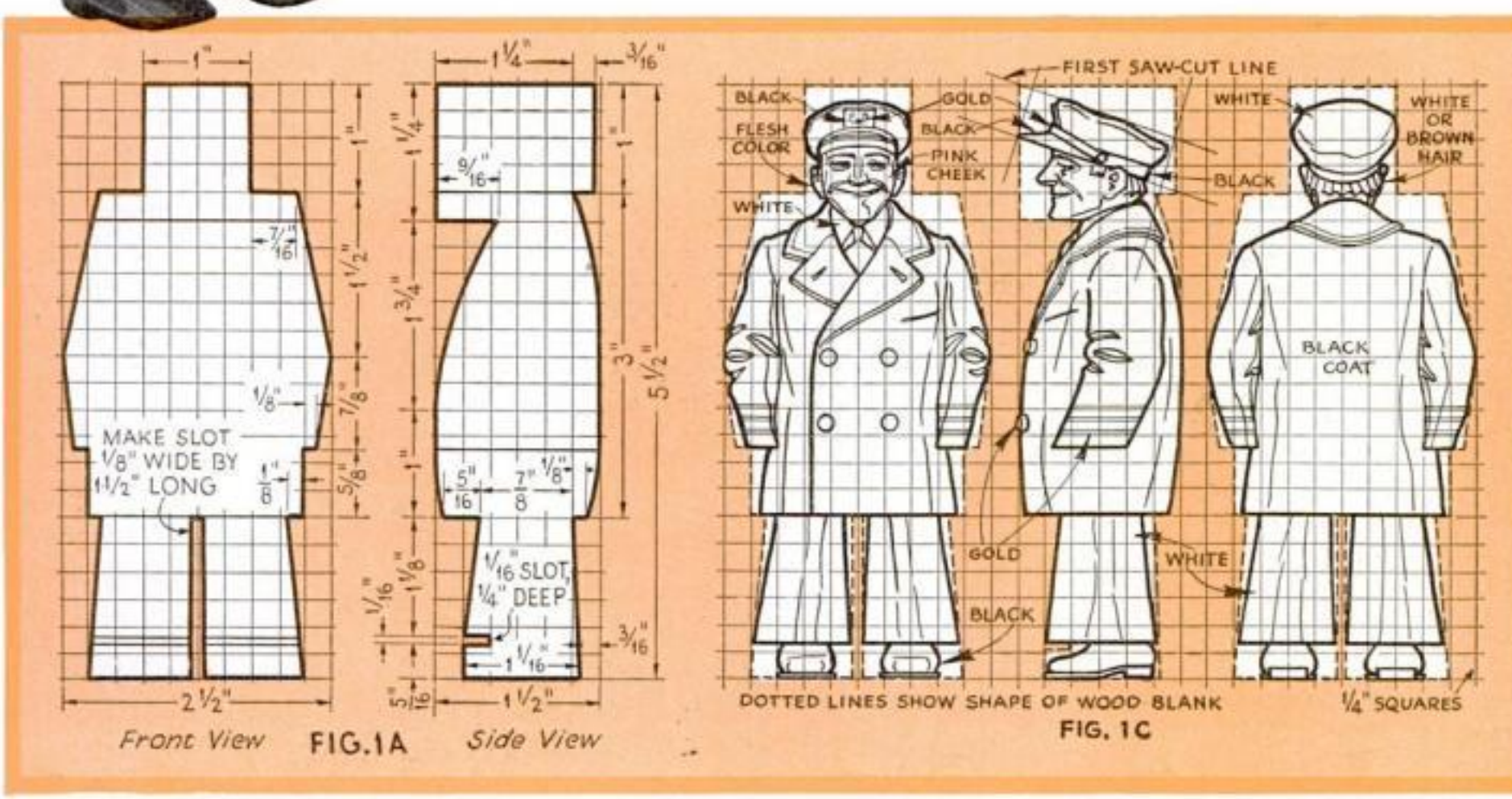
FIG. 1B

MEET Skipper Sam'l, white-haired, square-jawed old sea captain who once trod the deck of a speedy clipper fighting her way 'round the Horn to China. You can bet that one of the gnarled hands thrust deep into the pockets of his weather-beaten old pea-jacket is fondling his jackknife, universal tool of sailormen. So it's only right that he be immortalized in wood with his own favored tool—the knife.

This genial old salt was originally whittled out by a French-Canadian craftsman, to whom all credit is due for the novelty of the design. For the figure you require a bit of straight-grained softwood (white pine or basswood) 1½ by 2½ by 5½ in., a sharp knife, and a little patience. You don't need any special skill or previous experience in carving.

First, lay out ¼-in. squares on the front and right-hand side of the block. On this checkerboard lay out the front and side outlines of Fig. 1A. Now saw in all the horizontal lines from the sides—tops of shoulders, bottoms of cuffs, bottom of coat. From front and back, saw in under the skipper's chin and at the back of his neck, at the front and back of his coat, and the slot that divides his shoes from his trousers, which goes in ½ in. deep from the front face of the block. Next saw the ⅛-in. slot between his legs to the bottom of his coat. Shave off 1/16 in. at the back of his head, round up his back and the tail of his coat, and saw off ¼ in. of wood back of his pants.

The cuts you've made so far haven't destroyed any outlines of the blank, but from now on, every cut will remove part of the pattern. Saw away the waste wood at the sides of the head and *(Continued on page 90)*



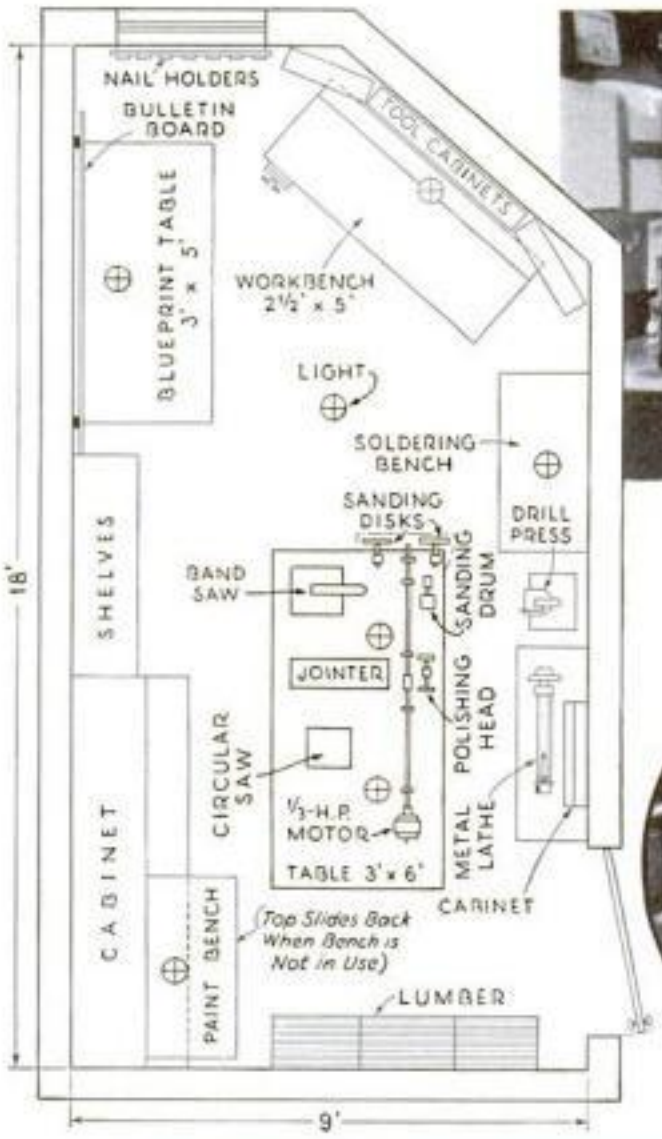
How to lay out the blocks, and three views of the finished figure, all exactly half size. Skipper Sam'l himself is shown in the photograph above

Save time by using our simplified construction kits, listed on pages 88 and 89.

Home Shop Planned for Easy Moving

THE home workshop shown in the accompanying illustrations has been added to our series of well-planned layouts because of its compactness and the fact that it has been especially designed for ease in shipping. It has been set up in San Antonio, Texas; Detroit, Mich.; New Orleans, La.; Ann Arbor, Mich., and Oakmont, Pa.

Homer O. Williams, Jr., a 20-year-old student, is the owner of the shop. He has spent six years in assembling the tools and equipment, which are used mainly for toys and model work. The main workbench, tool cabinet, and other shop furniture have been made as light as possible without sacrificing the strength required to stand up under ordinary work and also to resist the stress and strains of shipment.

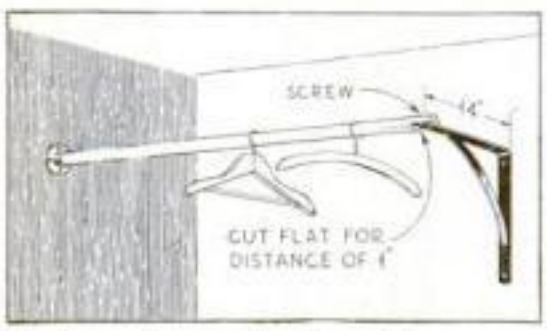


Main woodworking bench with portable tool cabinet and, at left, a convenient case for holding nails

Layout showing compactness of shop and, in oval, how woodworking machines are set up

Cabinet for paints, finishes, and chemicals. The working top slides back when not in use

A WARDROBE HANGER FOR SUMMER COTTAGE



Wooden curtain pole fastened in a corner of a cottage room to hold clothes hangers

LACK of sufficient closet space in the summer cottage or cabin can be relieved by using a simple wardrobe hanger as shown above. It may be attached in any corner, where it takes up a minimum amount of room and is sturdy and serviceable. As indicated in the drawing, one end of a 3-ft. curtain pole is fastened with a regulation bracket to one side of the corner, and the other end is supported by an ordinary shelf bracket, attached to the other wall.—E. V. B.

MODERN SHELVES OF GLASS AND COPPER

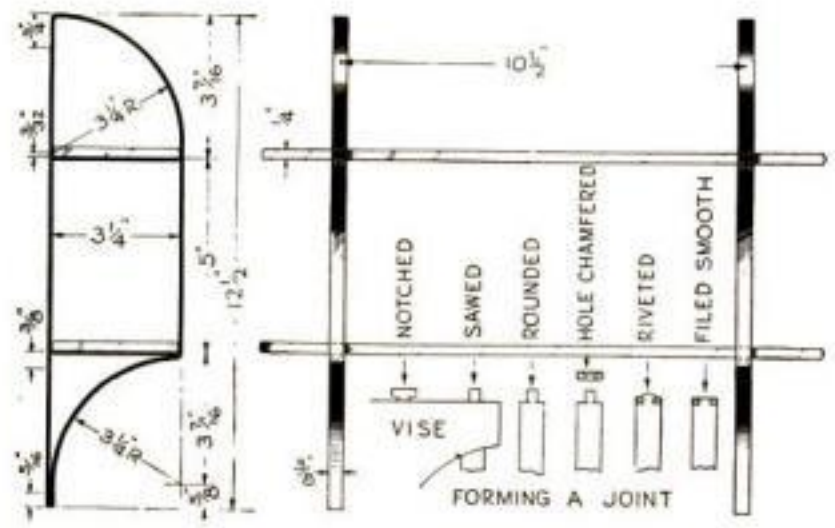
SMALL modern-looking shelves of copper and plate glass may be made as shown below. The metal parts are 3/32 by ⅜ in. copper bus-bar strip. Two pieces 29 in. long, two 3⅝ in., and two 3½ in. are required, together with two pieces of plate glass 3¼ by 14½ in., four rivets, and four No. 6 roundhead wood screws.

The piece may be made proportionately larger if wider strip is used. Should metal in bar form not be obtainable, strips from ⅜ to ⅝ in. wide may be cut from sheet metal 1/16 to ⅛ in. thick. Copper, brass, aluminum, and monel metal are suitable.

The metal is best shaped by using a full-size drawing as a pattern. The curves are bent over a rounded surface either by hand or with a soft mallet. The ends of the shelf-support strips may be bent and riveted, but riveting the strip itself, as shown, is neater and takes no longer. Note that the outer end of the lower supports and also the lower end of the brackets are riveted in the usual way. Heavy copper wire will do for the rivets.

File the rivet heads flush with the surface, file the edges where they are defaced from riveting, test the frame for squareness, and drill 9/64- or 5/32-in. holes for mounting. Next smooth with fine emery cloth, and if a full polish is preferred, finish on a buffing wheel. Clean thoroughly and apply a thin coat of clear lacquer.

Plate glass about ¼ in. thick is used for the shelves. Old automobile windshields are a good source. All edges should be ground smooth. In the home shop this may be done by running a fine emery wheel at a rather slow speed and having it dip in water.—RALPH L. KUNAU.



Decorative miniature shelves of plate glass supported by brackets made from copper bus-bar strips

KNOT-WORK Slippers

for Summer Lounging
for Beach Wear
for Bathing

Fig. 1. The soles are marked on a sponge-rubber chair or knee pad and cut out with large shears. *At right:* Completed slippers

By Kenneth Murray

THE wearing of these novelty bath slippers, or mules, gives an impression of walking on thick, luxurious rugs such as no cold bathroom floor has ever boasted. A pair can easily be made by tying square knots in cords attached to a pair of soles cut from a sponge-rubber pad. They can be changed from mules to soft, spongy beach shoes merely by carrying the knotted cords farther to the rear, around the heel. For ordinary outdoor wear, the cords may be knotted to thin leather soles, to which you can attach ten-cent rubber half soles and heels, obtainable in any department store.

To make a pair of bath slippers like those shown in the oval above, get a 25-cent sponge-rubber chair or knee pad, such as are sold, in different colors, at department stores. They are made in thicknesses ranging from ⅜ to ½ in. Use a pair of shoes as a pattern and mark around them, on the pad, with a crayon pencil. In cutting out the soles, use large shears, but make only short cuts (Fig. 1.).

Now thread a large darning needle with a length of black knot-work cord, and stitch the edges of the soles as shown in Fig. 2. Make the stitches wider on the top of the sole, and slant the needle to the inside as it is pushed from top to bottom.

Twenty 5-ft. lengths of strong white cord were used in making the uppers of the slippers illustrated. Of course, you may also use colored cord, or silk cable cord, if you wish. Each cord, after being doubled, is anchored to the sole stitching as shown in Fig. 3.

Starting with the four cords at one side, make widely spaced square knots by tying the outside cords over the inside cords of each set of four, as shown in Fig. 4. This is continued until the toe covering is partly knotted, when the slipper should be fitted to the foot (Fig. 5). You can get a perfect fit by making the knots closer or wider apart. This is very important. Fit the slipper often, and space the knots accordingly.

After the toe part is well under way, carry the knotting back, towards the heel. Fasten the work down at each side (see Fig. 6) so that the knots in the middle can be made more easily. After all twenty of the cords have been knotted, it will be necessary to anchor each row of knots to the sole by passing the cords on the sides through the loops of stitching.

When the knotting has been carried on as far as necessary, it is finished off with a row of half-hitches (Fig. 7). Take a loose cord from one side and bring it across the width of the slipper, over the instep. With each of the other loose cords, make from one to four half-hitches over the single cord, as may be necessary for the correct length of the row. Pull the half-hitches (which are ordinary "granny" knots) up very tightly. From the underside, cover them with ordinary nail polish, which will penetrate quickly and, in drying, make the knots very hard. You can then cut each cord off closely with a razor blade.

The slippers might be completed here, but it is better to add a thin leather sole to protect the stitching cord from wear. Rubber cement may be used, but a stronger material, (Continued on page 85)

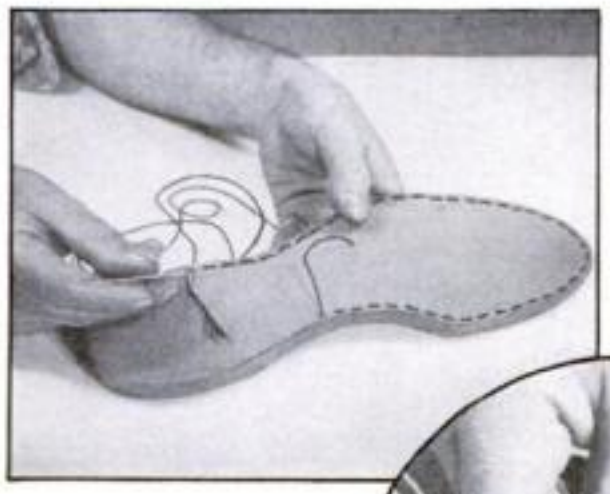


Fig. 2. Stitches should be made around the edges of the soles with black knot-work cord in a large darning needle. Have the stitches on the top wider and closer to the edge

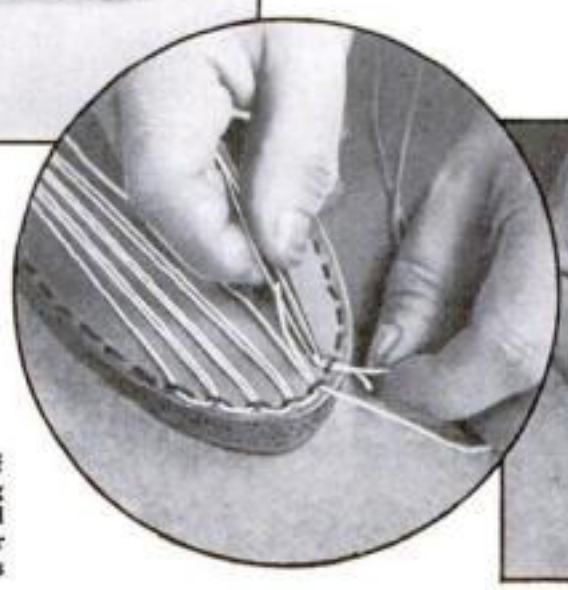


Fig. 3. Twenty lengths of white or colored working cords are used. Each should be doubled and slipped under one of the sole stitches

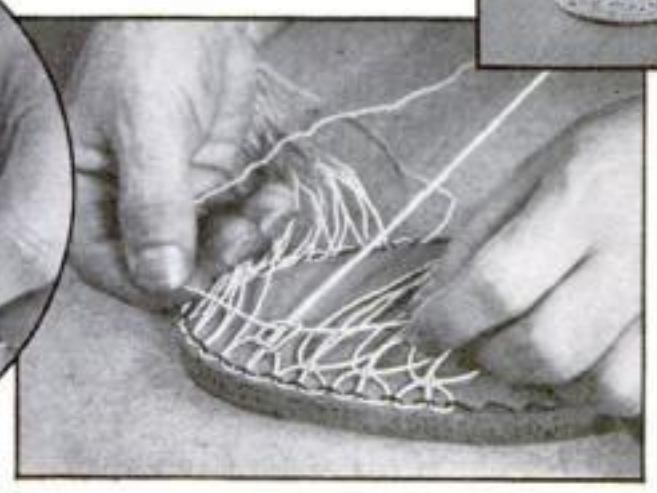


Fig. 4. Widely spaced square knots are made with each set of four cords, the two outside cords being tied over the inner cords. Continue until the covering is partly knotted

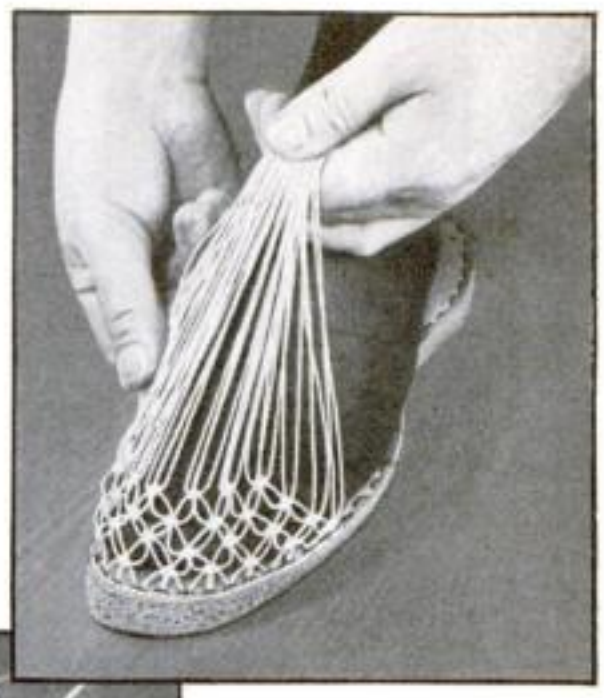
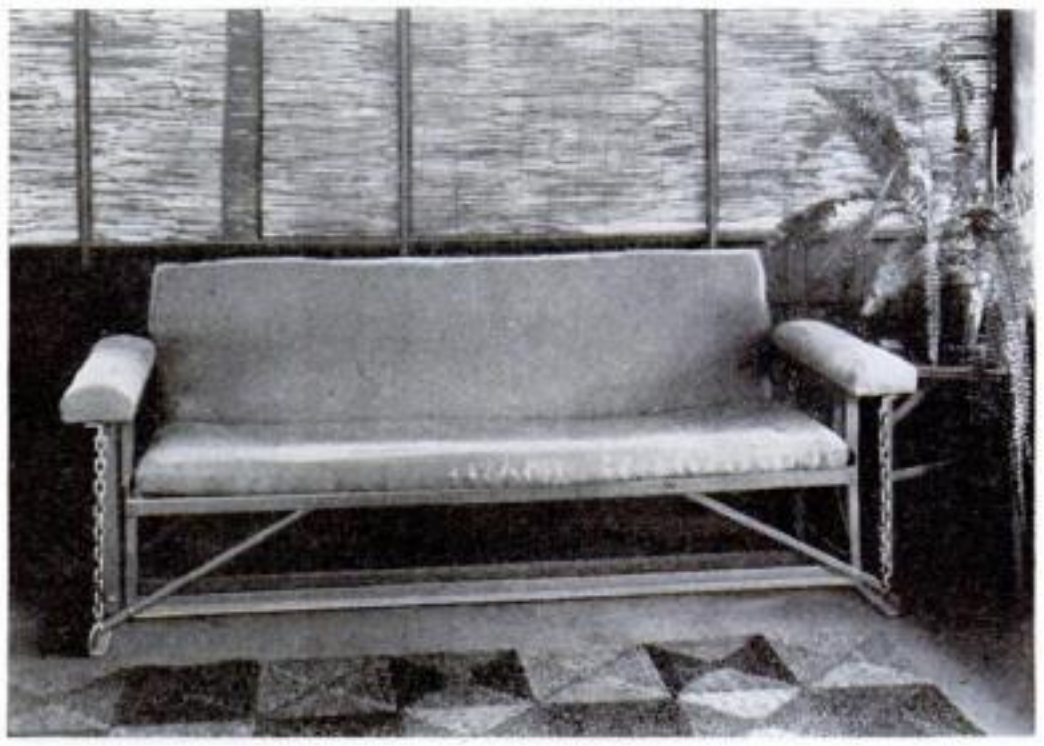


Fig. 5. As the knotting proceeds, the slipper should be fitted to the foot. Then the knots may be spaced closer or wider as found necessary

Comfortable Porch Glider

BUILT FOR TEN DOLLARS

The seat, back, and arms are a single unit suspended by chains from a framework, or cradle, made as shown in Fig. 1 below



By
Charles F. Deerwester

WELL-MADE porch gliders are expensive, but a comfortable one can be constructed at home from angle iron and bar stock, a length of chain, an old cotton mattress, and the link springs from a discarded cot. A coat of light green enamel and slip covers of light orange completed the glider illustrated, and the total cost was slightly under ten dollars.

For the seat and back frame, 1¾-in. angle iron is used, and for the cradle and arm supports, 1½-in. After the angle iron has been obtained, it should be cut into the following lengths: 1¾-in. angle—3 pc. 73 in. long, 2 pc. 24 in. long, and 2 pc. 19 in. long; 1½-in. angle—2 pc. 32 in. long, 2 pc. 79¾ in. long, 4 pc. 21 in. long, 4 pc. 25 in. long, 2 pc. 8 in. long, and 4 pc. 11 in. long.

Some ½ by ½ in. solid iron is desirable for leg bracing and also for the support upon which is mounted the chain by which the swing is hung—4 pc. 25 in. long, and 4 pc. 15 in. long. The chain should have links about 1¼ by 1¾ in., and should be cut into 4 pc. 18 in. long.

Mount and bolt the two 79¾-in. pieces to the 32-in. end pieces as indicated in Fig. 1. Use ¾ by 3/16 in. stove bolts for the assembly. Next bolt the two 21-in. uprights to each end and surmount these with the two 25-in. pieces, one at each end.

Next, assemble the frame for the seat. Mount the two long members, angle edge down, and the end members, angle edge up, as indicated. Measure the mesh of the cot springs and drill holes around the frame to accommodate the small hook springs. Mount the springs within this frame and attach the legs and leg supports as in Fig. 2. Although it is necessary to brace the legs from both angles, this not required in building the cradle.

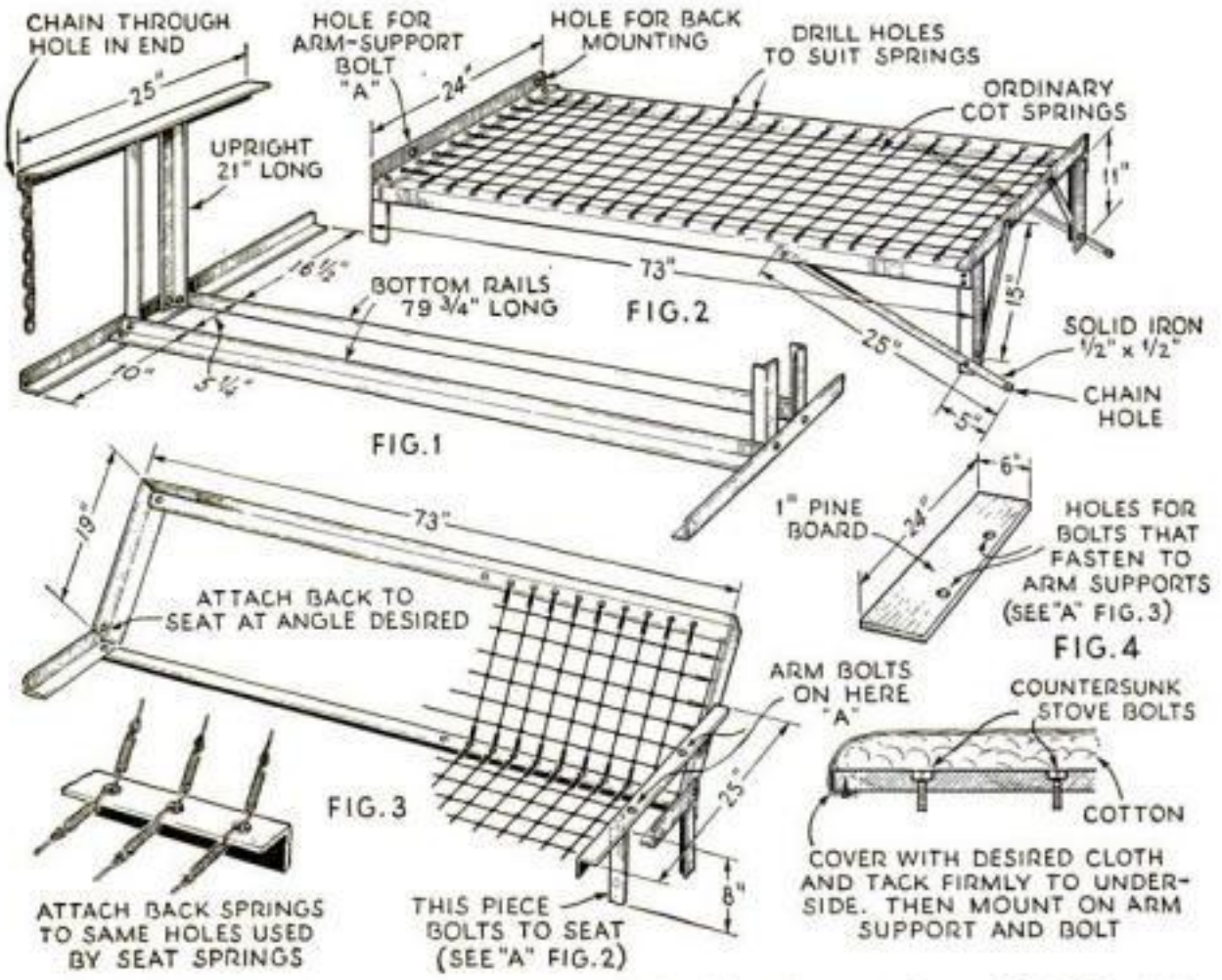
After the seat has been assembled, proceed in a similar manner with the back. All the angles on the frame for the back point in toward the seat. If the back is set properly into the seat frame and bolted on at the proper angle, no bracing need be done. Next insert the springs into the back frame. Hook the springs along the bottom edge into the same holes as were used in the seat for the seat-hook springs.

Put the arm supports in place and set the entire assembly in the cradle, suspending it with the four lengths of chain. Cut the end links on each chain and spread into hooks; then attach to the holes indicated in Figs. 1 and 2.

The arms are made of any available wood, with holes drilled to match those indicated in Fig. 3. Countersink the bolts to prevent turning, apply sufficient cotton padding, and cover with the desired fabric. This cover should be tacked firmly to the underside and the edges sewed shut with the ordinary type of baseball stitch. After completing the arms, mount them in place and bolt on tightly.

Any size mattress can be reduced to the desired size by cutting the cover, removing the excess, and resewing. The seat cushion should be 24 by 72½ in., and the back cushion 20 in. wide. The back cushion will then be 1 in. wider than the back frame, but this is to allow for contraction.

Paint the ironwork any desired color.

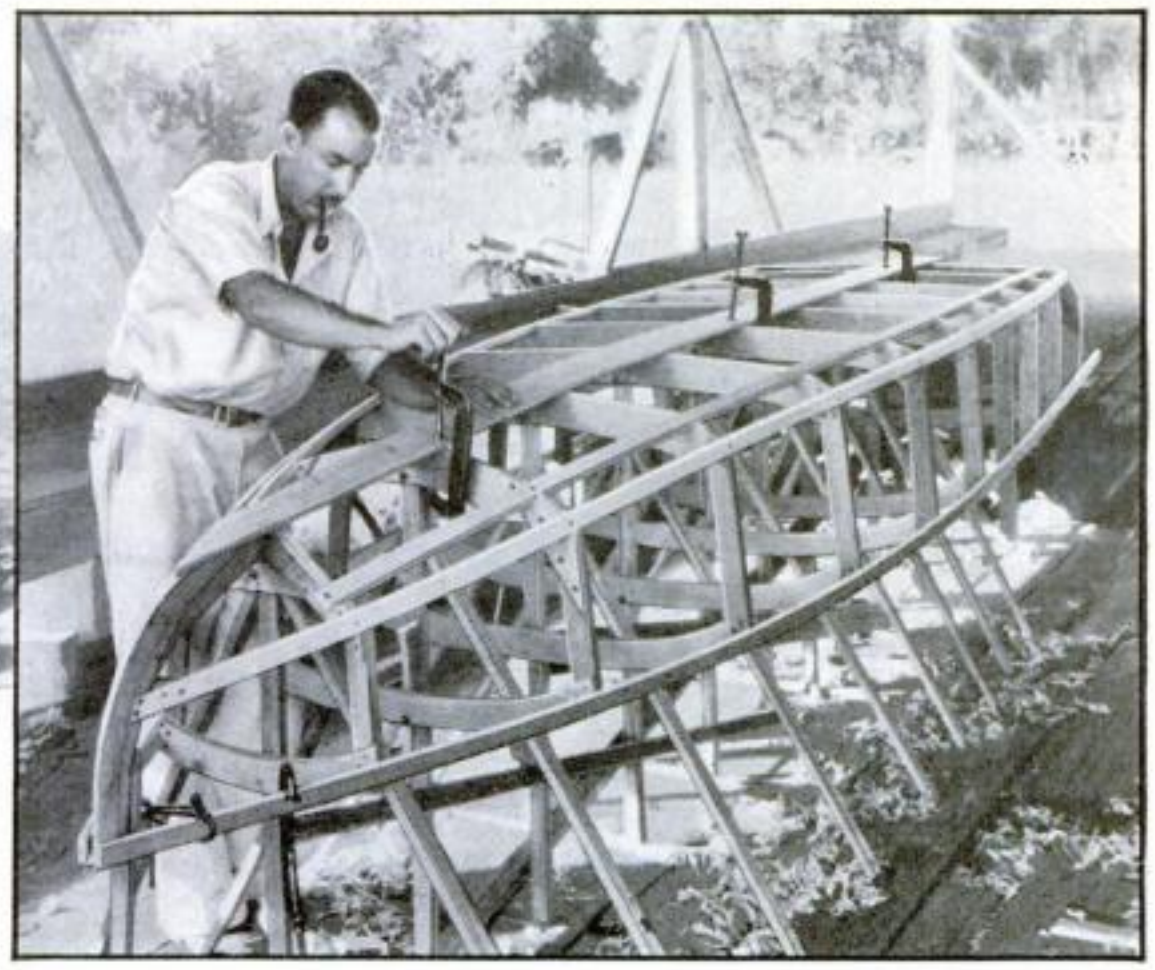


How the cradle and seat proper are constructed. The dimensions may be modified if desired

PLANKING AND FINISHING OUR NEW

Racing Runabout

Stern view of the new stepless hydroplane designed especially to meet national racing rules. Note arrangement of tiller lines. *Right:* Plank clamped in position for fitting



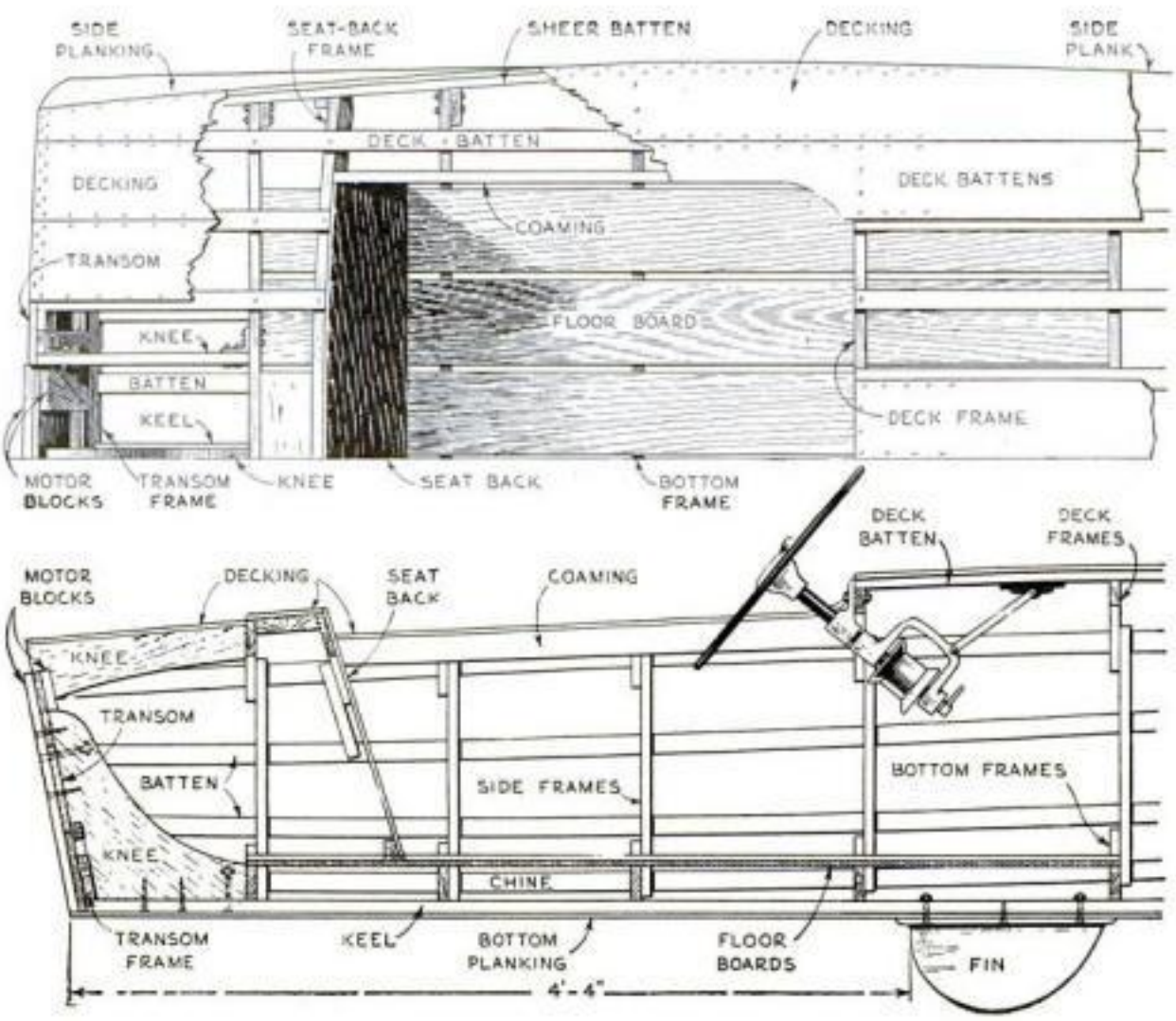
By WILLARD CRANDALL

from a design by

BRUCE N. CRANDALL

WHEN the framework of our new 13-ft. outboard racing runabout has been completed to the point described last month (P.S.M., June '35, p. 60), it is ready to be planked.

Three bottom battens are required on each side of the keel. They should be placed so that the planks will all be the same width at the transom. Forward, the battens should be placed essentially as shown in the drawings. The side batten next to the chine should run at the water line from the transom to frame No. 8. Take particular care in fairing up the upper side batten (the sheer line), as it will make a great deal of difference in the appearance of the completed boat. Fasten the battens to the stem, frames, and transom frame with 1¼-in. No. 7 screws. It will be best to check the entire framework again before starting the planking, to make sure it is perfectly true and fair. A light batten laid over the frames will show any unevenness.



There will be five bottom planks on each side of the keel, all of which will require fitting. If the battens are spaced approximately as shown in the drawings, the first two planks on either side of the keel can be made from 6-in. boards, but 8-in. widths will be required for the rest of the planking. All the planks should be fitted so that the seams come exactly over the center of each batten. The various planks can be fitted by clamping them in the proper position and then marking them from the inside along the battens with a pencil. Then, with the aid of a light batten, mark out the shape of the plank, first adding to each side of the plank one half the width of a batten.

Another method of marking the planks is to chalk the center line of each batten before clamping the plank in place. Enough of the chalk will come off on the plank to show reasonably accurately what shape it should be. An ordinary pencil compass will also be of use in marking the planks for the final fitting. The planks below the water line should not be fitted together tight; the seams should be left open about 1/16 in. to allow for swelling.

The outside bottom plank will have to be made in two pieces, spliced as shown between stations 5 and 6. It will also be easiest to stop the third and fourth plank (counting out *(Continued on page 92)*

Here is part of one of the display stands at the first National Handicraft Exhibition and Contest of the National Homeworkshop Guild. The larger models were set out on flat-topped stands, and a few fragile exhibits were placed in glass cases

THE NATIONAL HOMEWORKSHOP GUILD Shows What

WHAT the National Homeworkshop Guild has already accomplished in encouraging amateur craftsmanship throughout the country can be judged by studying the examples of craftwork illustrated on this and following pages. These photographs supplement those published last month, when the prize winners in the first National Handicraft Exhibition and Contest were announced (P. S. M., June '35, p. 57).

Innumerable letters and newspaper clippings have been received commenting upon the exhibition. They are all in agreement that the work being done by the Guild to get clubs organized represents the greatest step forward ever taken in the home workshop field. The success of the exhibition was immediately reflected in the increased membership of many clubs, particularly those in the Chicago area, and many inquiries as to how to start new clubs.

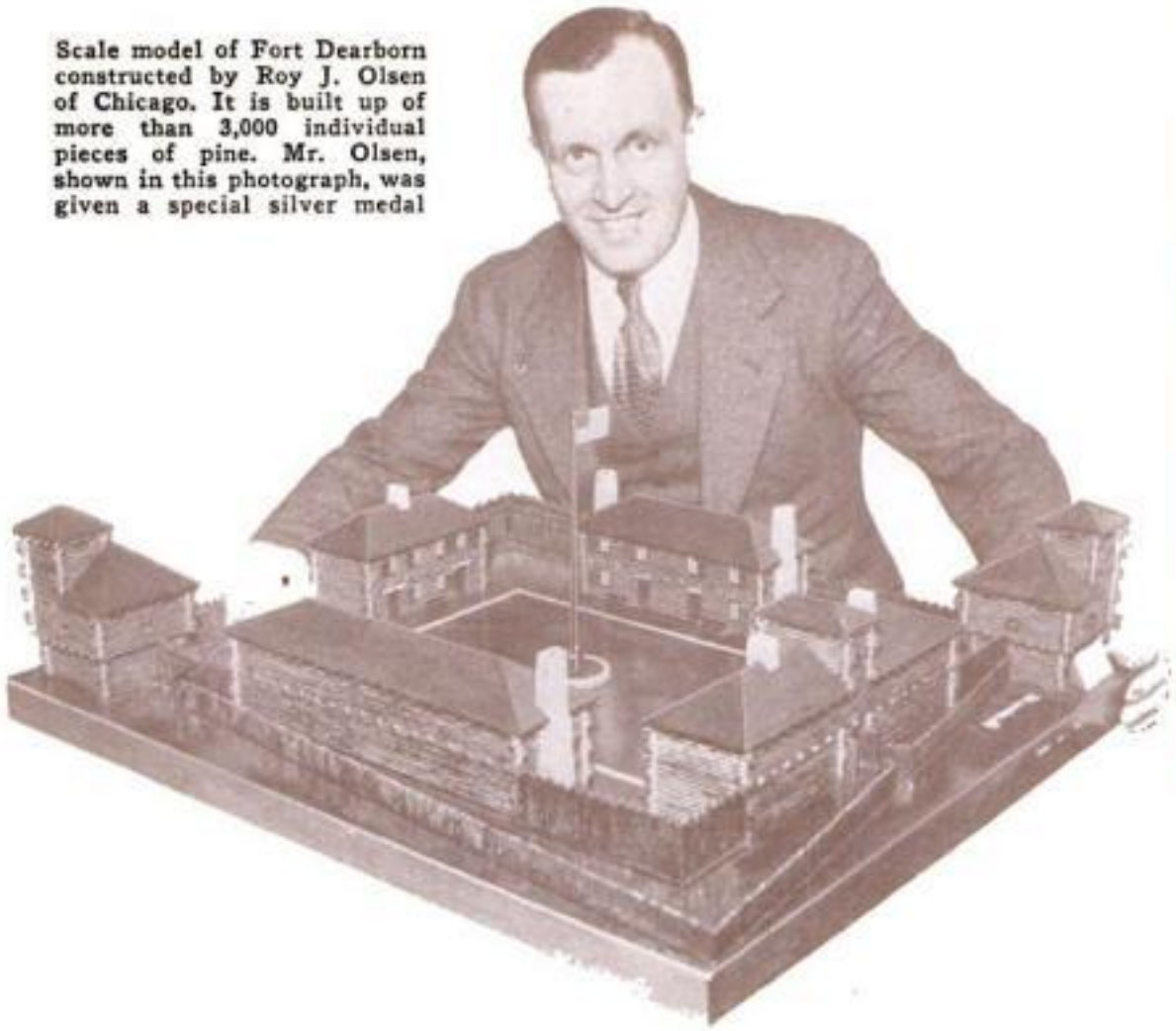
In checking up the records of the national contest, it was found that the star performer of the great Chicago show was A. O. Stenwick, a member of the Red Wing (Minn.) Homeworkshop Club. He won first in Division 7, novelties and toys; second in Division 3, furniture made with hand tools, and a special silver medal in Division 8, model making.

Mr. Stenwick, a photograph of whom appeared in the previous issue (P. S. M.,

Model yawl, first in model making, with F. F. Threadgold, mechanical superintendent of Guild exhibition

Reproduction of a thirteenth century vestment chest made from wood taken from an imported chest of drawers known to be over 100 years old. It won second prize for Theodore T. Clemesha, of San Diego, Calif., in the machine-made furniture division

These four pieces, made entirely of safety matches, won for Fred Spinden, of Abingdon, Ill., second prize in the division devoted to novelties and toys. The tea kettle and coffee pot are hollow—only as thick as one match



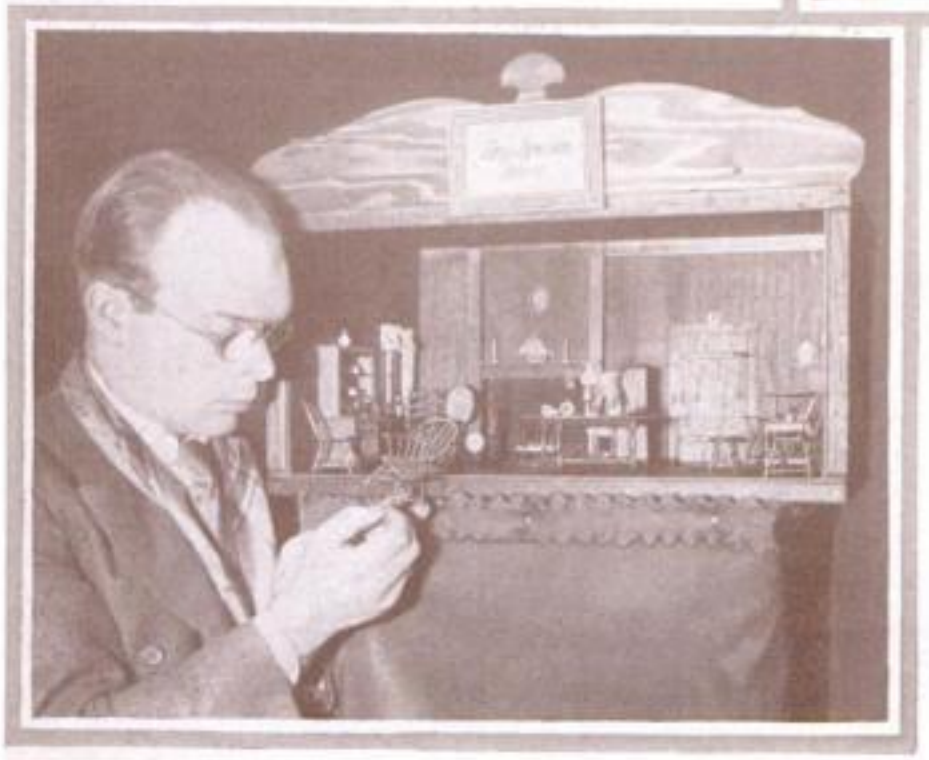
Scale model of Fort Dearborn constructed by Roy J. Olsen of Chicago. It is built up of more than 3,000 individual pieces of pine. Mr. Olsen, shown in this photograph, was given a special silver medal

A turned buffet set—fruit bowl and two candlesticks—made of walnut and white holly, with an inlay in the center of the bowl of vermilion and walnut set in holly in the form of two birds. This entry won second prize in the wood-turning division for Robert B. Dyer, of the Lincoln (Nebr.) Homeworkshop Club, and was also awarded the Popular Science Craftwork Medal in the local exhibition of the Lincoln Club

Its Members Can Do

A PICTURE RECORD OF OUTSTANDING ACHIEVEMENTS BY AMATEUR CRAFTSMEN

June '35, p. 94), is 60 years old and has been doing woodwork since he was a small boy. Some time ago a walnut tree on the grounds of a hospital across the street from his home blew down. He obtained part of it and sawed out a section, which he split in half. From one of these halves, he carved the lion in the cage that won first prize in the novelty division. After roughly shaping the block, he drew lines representing the bars of the cage, bored a number of holes between the bars, and completed the carving with his pocketknife and a set of six small carving tools that had been given him. All the carving on *(Continued on page 86)*



One of three locomotives exhibited by John Matthews, of Chicago — a very powerful working model of coal-burning type. A silver medal was won by the builder

Left: Miniature Early American interior made by F. L. Stoutimore, of Chicago, with the assistance of Mrs. Stoutimore. Each object is an accurate scale model of some authentic piece of furniture. Alexander Maxwell, secretary of the Chicago Premier Club is shown examining one of the chairs. *Right:* A fine table

Switch Saves Money *on* Photo Lamps

And Other Hints for Amateur PHOTOGRAPHERS

The lamps are used at full brilliance only while the picture is actually being taken

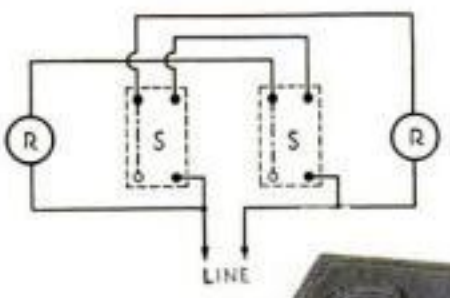
A DEVICE that will give the amateur photographer complete control over his photoflood lights may be easily constructed from parts obtained at a large ten-cent store or electrical supply house. The writer used two small three-way flush switches at fifteen cents each; two duplex flush receptacles at ten cents each; and two cover plates (each plate to accommodate one switch and one duplex receptacle, at twenty cents each.

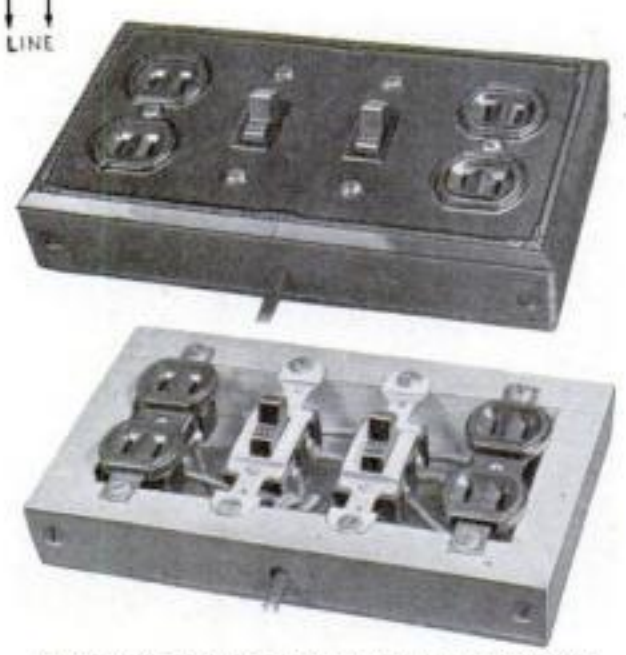
Carefully saw ⅜ in. from one edge of each cover plate—the edge where the slot is provided for the switch lever. This enables the switches to be placed closer together, facilitating the operation of both switches at one time. The plate should be held between two pieces of wood while being sawed.

The frame consists of two strips of wood ¾ by 1¼ by 8⅛ in., and two strips ¾ by 1¼ by 3 in. A hole is drilled in the center of one of the longer strips to provide for the lead-in wire. The bottom is made of plywood or other thin material 4½ by 8⅛ in. and may be covered with felt, if desired.

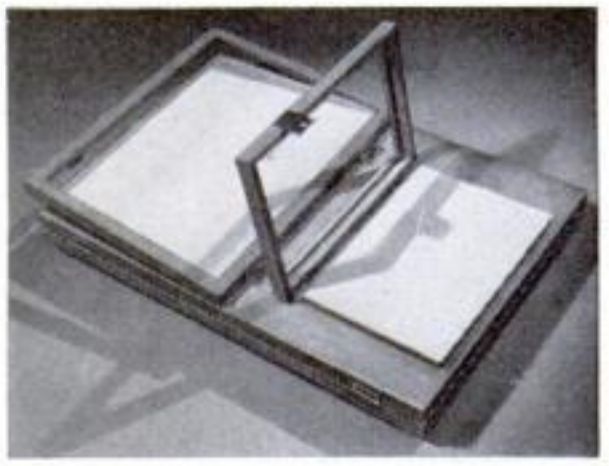
In the wiring diagram, each switch *S* is represented by dotted lines, and the terminals are indicated by black circles. The white circles connected by dot-and-dash lines represent permanent connections made within the switch by the manufacturer. They are not to be used. The large circles *R* indicate the duplex receptacles.

When both switches are "off" and two photoflood lights are plugged in opposite sides, the two lights will be in series. They may then be used for arranging the subject and for focusing without shortening their life. If either switch is now snapped to "on" and the other switch left at "off," one light will be put on full brightness and the other will be extinguished. If, however, both switches are snapped to the "on" position, both lights will burn at full brightness. When using four photoflood lights, all four receptacles may be utilized, the operation, of course, being the same as if two were used.—WILLIAM H. MCCLAIN.





How switches and receptacles are mounted; the completed device; and the wiring diagram



EASEL HOLDS TWO SIZES OF ENLARGING PAPER

ENLARGING paper may be held flat on the table and neat white margins obtained all around the prints by using a homemade easel like the one illustrated. It is for two of the most commonly used sizes of paper—5 by 7 and 8 by 10 in.—but it can easily be made for other sizes.

Obtain a baseboard of well-seasoned wood at least ½ in. thick and slightly larger than the size of the paper you are going to use. In the case of a double frame (as in the photo above), add the widths of the two frames plus about 3 in. Next, cut a frame from molding which has a ⅛-in. rabbet. This should be 1/16 in. larger each way than the size of the paper to be accommodated, or 8 1/16 by 10 1/16 in. for 8 by 10 in. paper. It might be well to have the frames cut from plain molding at a picture framer's unless you have access to an accurate miter saw. The frames are then hinged to the baseboard, and small spring-brass clips are fitted as shown.

The paper support, which may be of cardboard, must be equal in thickness to the depth of the rabbet. Cut it slightly smaller than the size of the paper to be used. A piece of white paper may be pasted on top of this to facilitate focusing and composition.—ALBERT C. MASON.

LENS SHADE FOR TEN CENTS

OF THE many camera lens shades I have tried, one made from a ten-cent teacup of the so-called "beetleware" type is the most durable and satisfactory. Remove the handle by sawing or filing. Tap a hole in the base and enlarge it with a round file. When it nears the outside diameter of the lens flange, finish with sandpaper and try frequent fitting to obtain a snug fit. Velvet may be cemented around the edge to prevent scratching. The whole shade also may be covered with matte black, if desired.

I made the shade illustrated in less than ten minutes. If fitted carefully, it is easily put on and taken off. For a smaller-sized shade, get a wine glass of the same type of material.—FRANK MACCARTHY.

MARKING THERMOMETER FOR DARKROOM USE

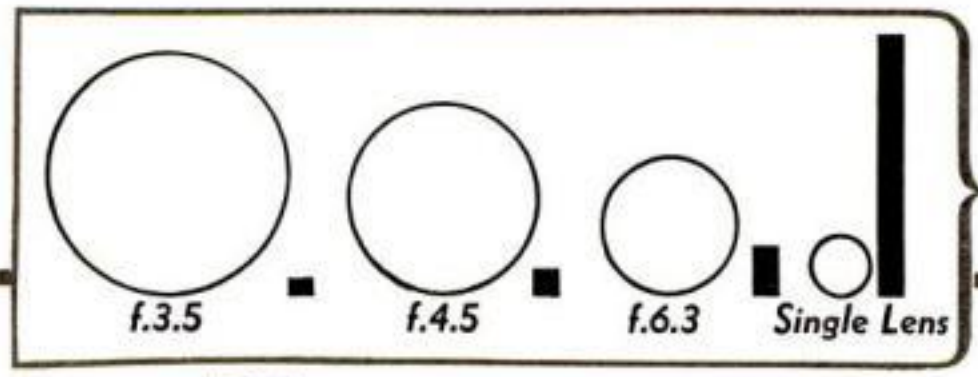
STIRRING-ROD thermometers of the type commonly used by photographers are difficult, if not impossible, to read in the dim light of a darkroom. They can be marked easily, however, by dipping a length of black thread in shellac and wrapping it around the glass at the point that indicates the desired temperature, as illustrated above.—W. EDWARD WHITE.

LENS SPEED...what it is...how to use it

THE faster the lens on your camera, the less light you need to take pictures. And the less light you need, the greater the variety of snapshots you can take.

Lens speed is denoted by an *"f"* rating —such as *f.*4.5 and *f.*6.3. The smaller the *"f"* number, the larger the diameter of the lens . . . hence, an *f.*4.5 lens admits more light—is bigger, therefore *faster*—than an *f.*6.3 lens when fully open.

When you buy a camera, get one with a good fast lens. It will let you take pictures at higher shutter speeds . . . and even indoors at night with Mazda Photoflood bulbs. Of course, you won't take all your pictures with the lens wide open—but, like a high-powered automobile, it's nice to have the extra power when you need it.

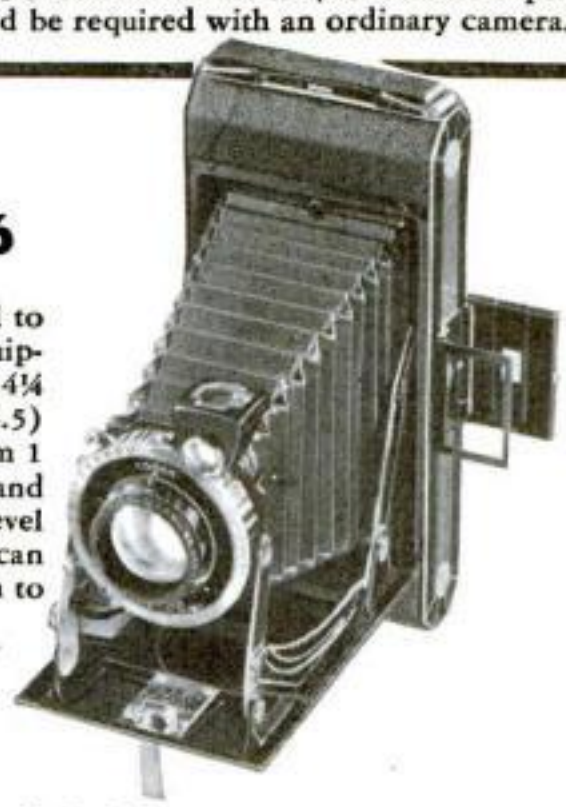


● Circles indicate relative openings of various lenses. Bars indicate relative times of exposure necessary. The bigger or faster the lens, the shorter the exposure that is needed. Notice that an *f.*3.5 lens is *16 times* faster than an ordinary single lens... thus, you can take action pictures at 1/400 second with an *f.*3.5 camera where a 1/25-second exposure would be required with an ordinary camera.

*f.*4.5 KODAK SIX-16

(right)

Kodak Six-16 with *f.*4.5 lens will appeal to those who know fine photographic equipment. It takes a standard-size picture—2½ x 4¼ inches. Its fast Kodak Anastigmat lens (*f.*4.5) and the Compur shutter with speeds from 1 to 1/250 second give you mastery of light and "action." Both conventional and eye-level finders. With the built-in self timer, you can get in the picture yourself. Focuses down to 4 feet—for fine close-ups. Costs $40.



*f.*3.5 KODAK DUO

(above)

. . . the miniature Kodak that makes a larger picture. In the rain . . . indoors . . . almost anywhere . . . at night with Photoflood bulbs, the crisp, sharp *f.*3.5 lens lets you take pictures. And the Compur shutter gives you speeds up to 1/300 second—fast enough to "stop" an express train. Just a handful of camera, this miniature Kodak gives you sixteen pictures on a roll of 620 Kodak Film. And each picture is 1⅝ x 2¼ inches, large enough for your album. Complete with depth-of-focus scale . . . Kodak Duo Six-20 costs $52.50.

*f.*3.5 KODAK RETINA

(left)

This miniature Kodak is built for speed. A 1/500-second Compur shutter gives you command of action—and the keen *f.*3.5 anastigmat lens admits ample light for high-speed exposures in difficult light. Thirty-six pictures, approximately 1x1½ inches, at a loading. And it's a real camera bargain. Complete with optical view finder, depth-of-focus scale, plunger release—Kodak Retina costs about half as much as cameras of similar range—only $57.50.

Kodak "SS" Film adds speed to any camera

Kodak Super Sensitive Panchromatic Film is a high-speed film for high-speed cameras—but it opens new picture possibilities to any camera. Try a roll or pack of "SS" Film—you'll find it helps get the pictures you may have missed before.

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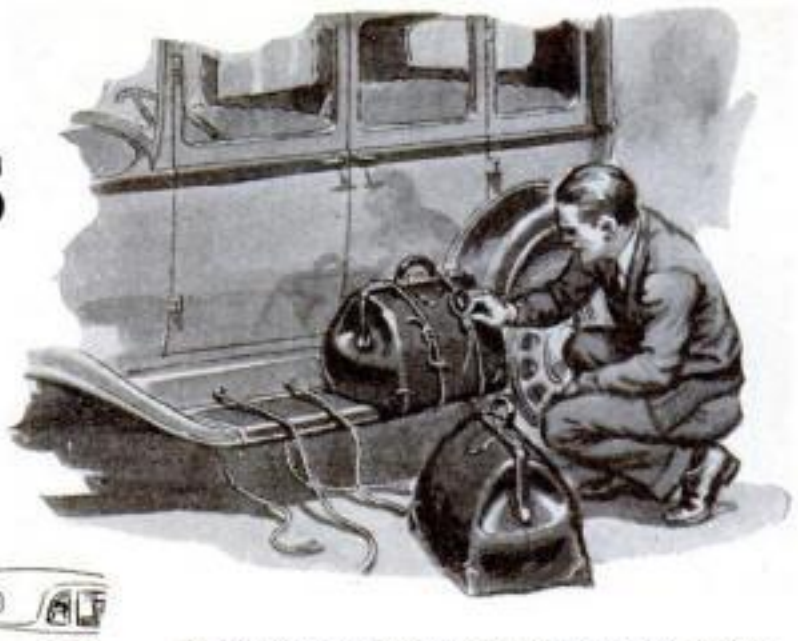
OUR READERS CONTRIBUTE THESE

Timely Hints FOR CAR OWNERS



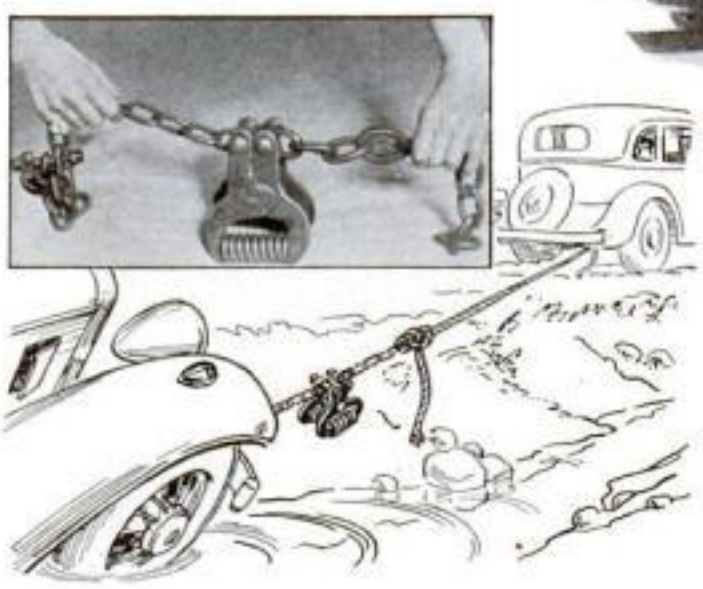
How valises can be fastened to running board of car

Luggage Carrier

FOUR holes placed in the metal splash apron along the side of your car will provide a handy means for fastening luggage, camping equipment, or bulky packages to the running board of your car. Strong cotton rope looped through the holes and under the running board will hold any sort of baggage in place. To prevent the rope from chafing on the sharp edges of the metal, each hole should be fitted with a metal awning grommet. The holes do not mar the appearance.—E.A.K.

Shock Absorbers Save Tow Rope

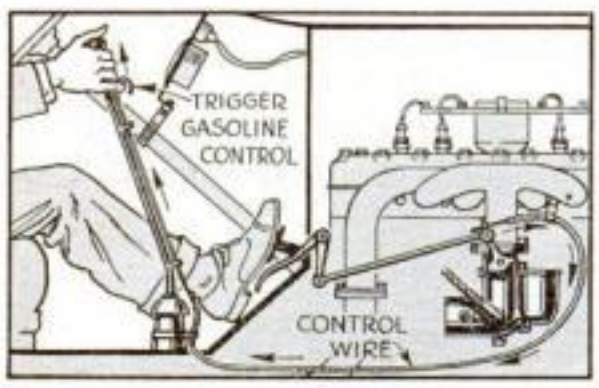
AFTER snapping at least three towing rigs pulling cars out of deep ditches and mud, I decided to find a way to ease the strain of the first hard jerk that invariably broke the rope or cable. The result is shown in the illustrations. It consists simply of two old-style spring shock absorbers bolted together, short lengths of pipe being used as spacers. Lengths of chain then were fastened to the arms to serve as connections to the car and tow rope.—A. E. G.



Shock absorber on tow rope keeps first jerk from breaking it

Tracing Cylinder Cracks

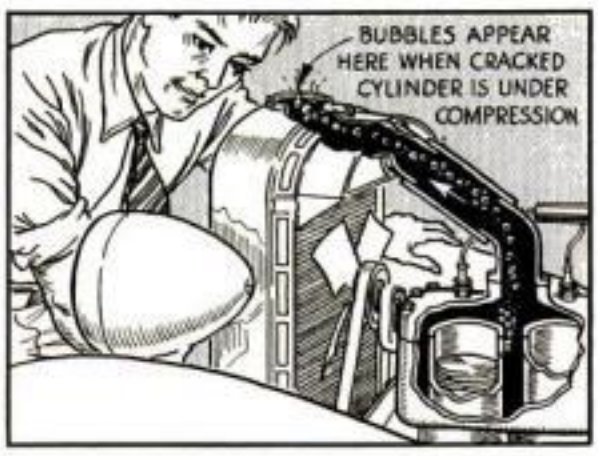
WHEN a motor develops a casting crack or a gasket leak and water seeps through into a cylinder, it is often difficult to determine which cylinder is at fault. To trace the leak without removing the head, fill the radiator with water and run your motor to bring it up to driving temperature. Then remove the radiator cap, shut your motor off, and turn it over slowly by hand. As the cylinder with the leak comes under compression, telltale bubbles will appear at the radiator opening.—E. J. N.



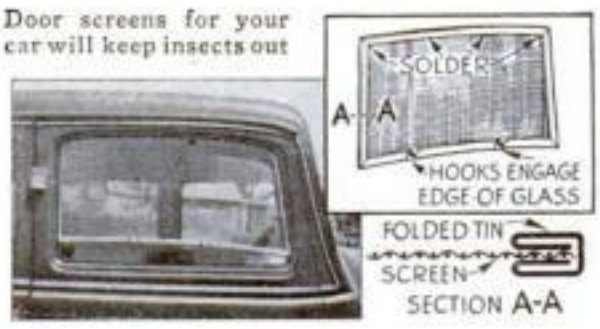
Gear-shift gas feed simplifies starting on hill

Throttle on Gear Shift

FOR starting a car on a hill without slipping backwards, few tricks are more effective than the homemade gear-shift gas-throttle illustrated. It allows you to use both feet on the pedals and yet leaves your hands free to guide the wheel and work the shift lever. The throttle is simply a trigger rod salvaged from a truck shift lever. It is mounted on the gear shift and linked to the carburetor throttle lever through a flexible cable. The hand that shifts gears can feed the gas.—C. G.



Door screens for your car will keep insects out



Screens for Your Car

YOU can make your car as mosquito-proof as your home by fitting it with the easily made door screens illustrated. Each screen frame is made up of four pieces of sheet tin folded U-shape and soldered to form a rectangle that is a tight fit inside the window opening. The screening, pushed into the open channels formed in the frame, is put in place before the parts are assembled. Two hooks, soldered to the bottom edge of the frame, rest on the top edge of the partly raised window to hold the screen securely in place.—E. E. H.

Replacing a Valve Spring

WHEN a valve spring breaks in an overhead motor, it can be replaced easily without removing the head. First remove or loosen the rocker arm. Solder a length of wire to the valve stem and loop it over the radiator rod. With the wire to prevent the valve from falling into the cylinder, the locking pin and washer then can be loosened and the broken spring removed. The new spring is then attached.—N. E.

Jack Extension Arm for Low-Slung Cars

TO MAKE it easier to jack up the rear wheels on my new streamlined car, I devised the permanent spring extension arms shown. Consisting of a right angle of three-eighths- by seven-eighths-inch steel bolted to the shackle on each rear spring, it provides a handy projection to take the head of the jack. The jack is simply placed under the extension and raised. As it moves up, it first pulls the spring out flat and then raises the wheel. Since the arms do not interfere with the spring action, they may be left on permanently.—C. F.

Extension arm clamps on spring so jack can lift low car

DO NOT be too hasty in discarding short drills. They prove handy where the work will not permit the use of a long drill because of the limited capacity of the machine or the size of the work. They also make good countersinks and specially formed two-lipped end mills.

• • •

Keep all threading tools good and sharp. Taps, dies, and chasers have a positive lead, and their cutting edges do more work than many other metal-cutting tools, where the feed is governed by the operator.

• • •

To drill aluminum, a 140-deg. included lip angle is recommended, and the cutting edges should be stoned. Use a higher speed and lower feed than required for steel.

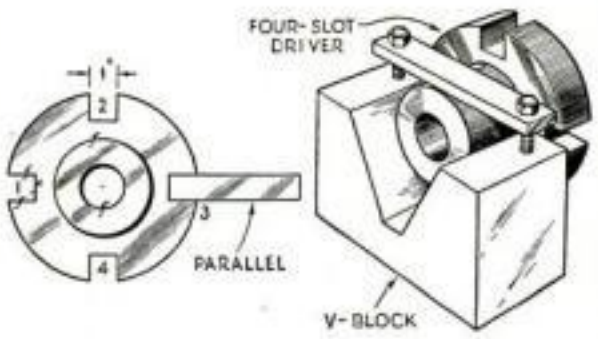
• • •

Use a cup wheel as much as possible for sharpening milling cutters, side mills, or end mills. A cutting edge resulting from a flat clearance will double the time between grinds.

• • •

In case any endless canvas belt gets too loose, sock it in hot water and allow it to dry overnight.

SPACING SLOTS WITHOUT A DIVIDING HEAD



INGENUITY often makes it possible for small machine shops to do work for which no adequate equipment is available. An example of this is the four-slot driver illustrated. It has four 1-in. slots equally spaced. These were ground within close limits without the use of dividing-head equipment.

First the rail of the magnetic chuck was ground true. Then the driver was mounted on the magnetic chuck by means of a V-block as shown, and slot No. 3 was ground to the correct depth and central to the hub. This was checked by holding a square against the hub and using a gauge block in the slot, gauging from square to gauge block. A 1-in. parallel 3 in. long was next inserted in slot No. 3, making a tight fit. The slot was then turned 90 deg., the parallel being set with the aid of an indicator.

Slot No. 2 was finished in the same manner. The work was then swung back to the opposite position and the parallel indicated again so that slot No. 4 could be ground. Finally 1-in. gauge blocks were fitted into slots Nos. 2 and 4 and indicated parallel, and slot No. 1 was finished.—F. J. WILHELM.

ANTIQUE

Tip-Top Table

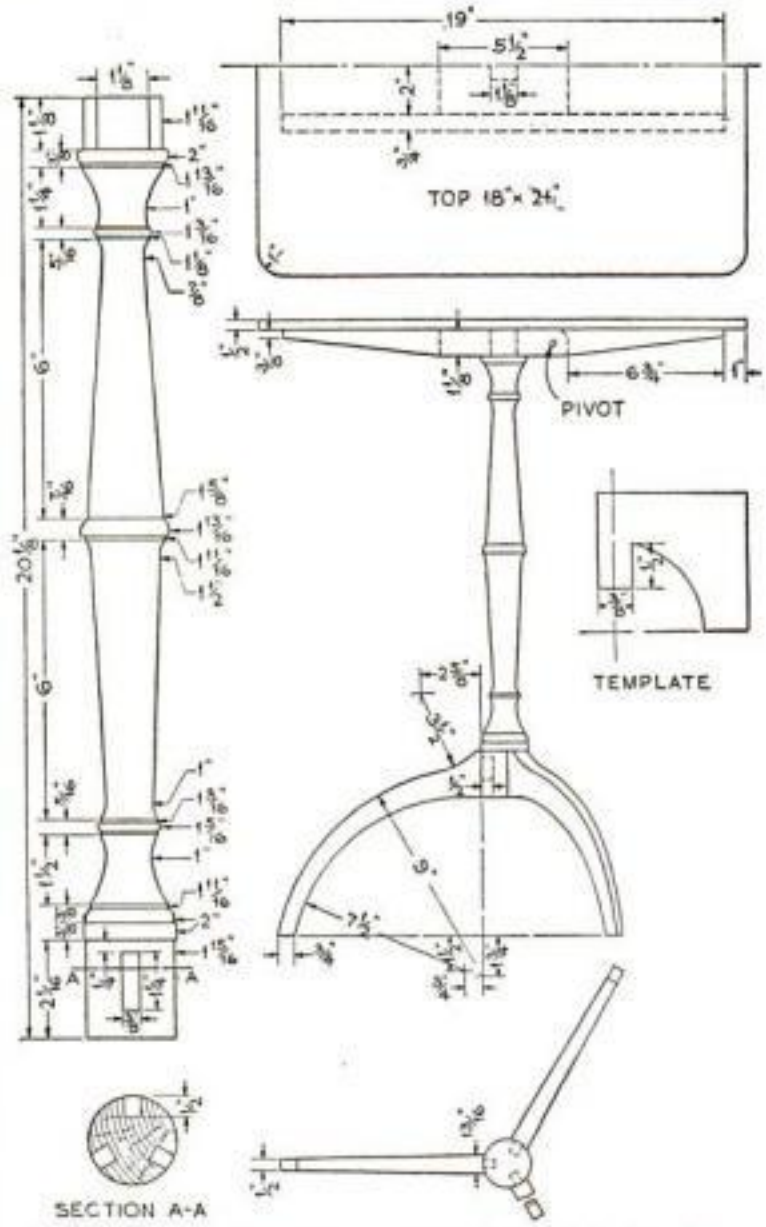
Measured drawings of a beautifully proportioned eighteenth century piece

By CHARLES PRICE

THROUGH the harmonious repetition of straight lines and tapers, an unusual perfection of design has been achieved in this eighteenth century mahogany table. The original—a genuine antique—is shown in the photograph. It should be noted that the tapered portions of the column are not perfectly straight, but have slight fullness that overcomes any feeling of skimpiness.

The material should be mahogany or walnut, although maple may be used. In turning the column, try to get a crisp effect by not rounding any edges that should remain sharp and distinct. This should also be kept in mind when using sandpaper. Use No. ½ sandpaper first; then finish with worn No. 0 grade. All sanding is done with the lathe running at full speed. A series of fine lines will be left running around the work; these are removed by sanding up and down with the grain while the lathe is not running. Use a piece of well-worn fine sandpaper for this. The work is then taken out of the lathe and the surplus ends sawed off.

The top end of the column is cut down from the round to form a square tenon 1⅛ in. on a side. This fits snugly into a corresponding mortise cut in the block, which should be glued in place and fastened with a dowel passing through the side into the tenon on the column.



Drawings made from measurements of the original antique, which is shown in the photo. Note template for mortises

The feet are mortised to the column. A template made from good stiff cardboard is necessary to get the mortises at the right angle. Measure the diameter of the base of the column and make the radius of the arc exactly half. The width of the projecting portion of the template should be measured from the center line. With a pair of dividers, mark off three equal spaces on the shaft. One mark should be directly in line with the center of the block on the other end of the shaft. This is necessary to insure the top being equally in line with both forefeet when it is tipped up. When laying out the mortises, it is advisable to clamp the base of the shaft lightly in a vise. Get the space mark in the center of the vise jaws; the edges of the vise can then be used as guides. Drill with a 5/16-in. bit and use the template frequently while chiseling out.

The feet are made of straight-grained wood free from any defects, the grain running in the general direction of the feet. Time will be saved by laying out a foot on cardboard and tracing all three feet from it. Saw the feet on a band saw and plane them to the required taper. Finish the curves with spokeshave, file, and sandpaper. Cut the tenons one at a time to fit the shaft snugly, and number each with its corresponding mortise. The end of the feet that fits against the shaft will

have to be worked down with a gouge until a close joint is obtained.

To glue the feet, put a wooden hand screw on the foot so that it is parallel to the shaft when the foot is in place. An iron C-clamp may then be used to draw the foot down, one part bearing on the wooden clamp and the other part on the shaft. A block of soft pine should always be placed between the clamp and the work. Clamping in this manner will allow only one foot to be glued at a time, but the joint will be stronger than is possible to get in any other manner.

The top of the original table is made up of two pieces 10½ in. wide and 18 in. long. Glue the pieces together, plane the surfaces, and select the better for the top. Plane the edges,

List of Materials

No. of Pieces	Description	T.	W.	L.
1	Top	½	18	21
2	Top cleats	¾	1⅛	19
1	Column	2⅛	2⅜	22
1	Block	1⅛	4	5½
1	Feet	13/16	7	12½

NOTE: Dimensions are given in inches.

draw 1-in. arcs at the corners, saw the corners, and finish with file and sandpaper. Sand all edges enough to remove the sharpness.

Make the two cleats as shown and fasten them to the top 4 in. apart with screws of various lengths. The top of the front edge of the block, which is pivoted between them, is rounded to allow the top to tip up. Two screws are used as pivots. A catch of the type especially designed for tip tables should be fastened to the top to hold it in place. If a regular catch cannot be secured, a small button on a block will answer.

The work is now smoothed all over with No. 00 sandpaper or fine steel wool and dusted off. Regular oil stain, brown or red in color, may be used. With a little more trouble, however, a stain preferred by some craftsmen, may be made—ten cents' worth of potassium bichromate mixed with a pint of water. If this or any other type of water stain is used, the work will have to stand for an hour to dry. It should then be rubbed with fine steel wool, as the water raises the grain of the wood slightly.

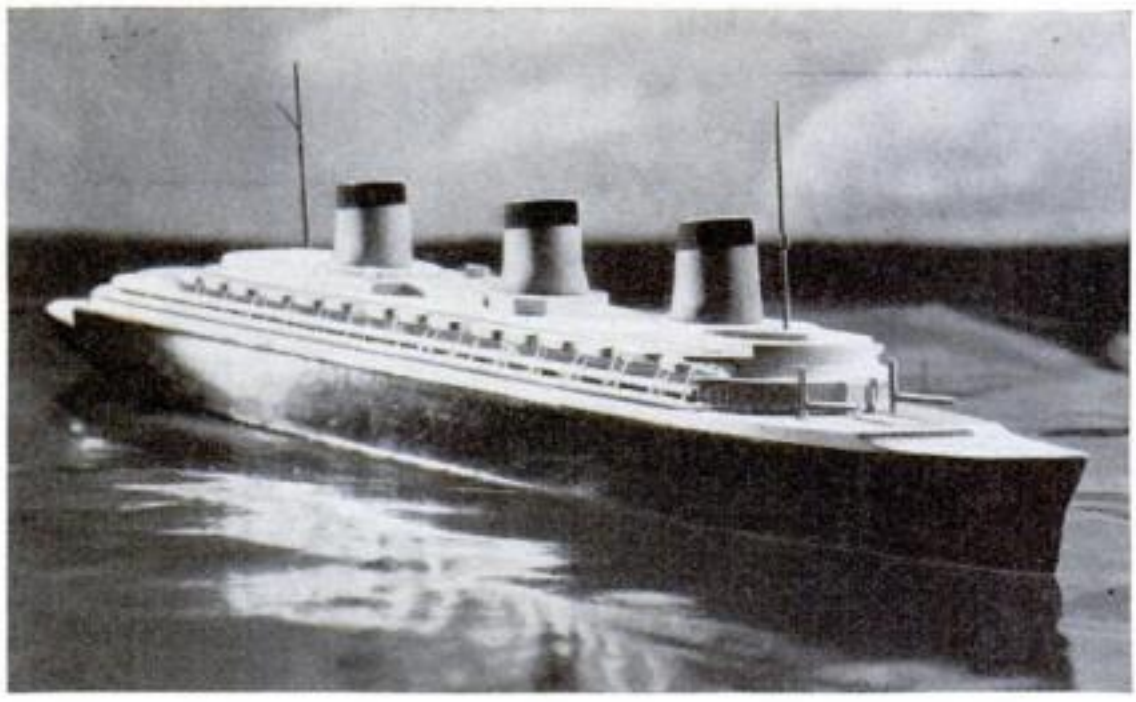
A coat of paste wood filler is next applied. If the proper color is not at hand, a few drops of regular oil stain may be stirred with natural wood filler to obtain the right shade. The filler is brushed on the work, a small portion at a time; and when it shows signs of drying, remove the surplus by rubbing across the grain with a cloth. Allow the filler to dry overnight. Two coats of thin shellac are then applied, the work being rubbed with steel wool after each coat. A coat of furniture wax, thoroughly rubbed, will give a pleasing sheen and complete the finish.

REMOVINGWEATHERPROOF COVERING FROM WIRES

WEATHERPROOF insulation, which is hard to cut, may be removed from wires more easily with a hammer than a pocketknife. Use light blows on the end of the wire while it is held against a brick wall, concrete, or any other hard surface. Under the blows the copper conductor quickly breaks through the insulating material.—LOUIS N. GOODMAN.

"WIRE" EDGES BUFFED AWAY

THE so-called "wire" edge on wood-cutting tools (chisels, planes, gouges, and pocketknives) can be quickly removed with water and pumice stone on a cloth buffing wheel. Lift the tool from buff frequently and use plenty of water and light pressure to avoid injuring the temper. This is especially handy on gouges.—M. A. COOPER.



SIMPLIFIED MODEL OF THE *NORMANDIE*

(Continued from page 59)

then be reduced to ½ in. in width, and four boats cut off. Two will serve as boats, and the other two are to have one end rounded as shown by the dotted line to form the streamlined ventilators that are fastened to piece *Z* (see Fig. 1). The two ¾-in. boats may be shaped out of scraps of wood.

Fasten the lifeboats to the paper strips so that they just touch the wire runways that constitute the new type davits with which the *Normandie* is fitted. The two small boats are directly behind the bridge; then follow the two motor launches; and the twenty-six regular boats fill the remaining spaces. Take great care in fastening these boats to the strips. Then, if your work in building the superstructure has been exact, you will find that the first six boats on each side are evenly spaced, and that the remaining nine are in three groups of three each, on each side. With small scissors, clip off any part of the paper strips that may project.

The funnels are of a peculiar shape. As Fig. 6 shows, the base is wider and longer than the top. Cut the ⅞ by 1¼ in. stock into three pieces, each 1⅛ in. long. Draw center lines all around the blocks thus formed. Make exact patterns on cardboard of the base and top. Trace these shapes on the blocks. Whittle away until each funnel looks like a section of a streamlined cone. Next cut away wood on the sides so that the shape of the top drops perpendicularly until it is within ¼ in. from the base, where it starts to flare out. Now trim the tops. In doing this, note that the front edge of the first funnel remains the full 1⅛ in. it originally was, while the second is only 1 1/16 in. (Continued on page 77)

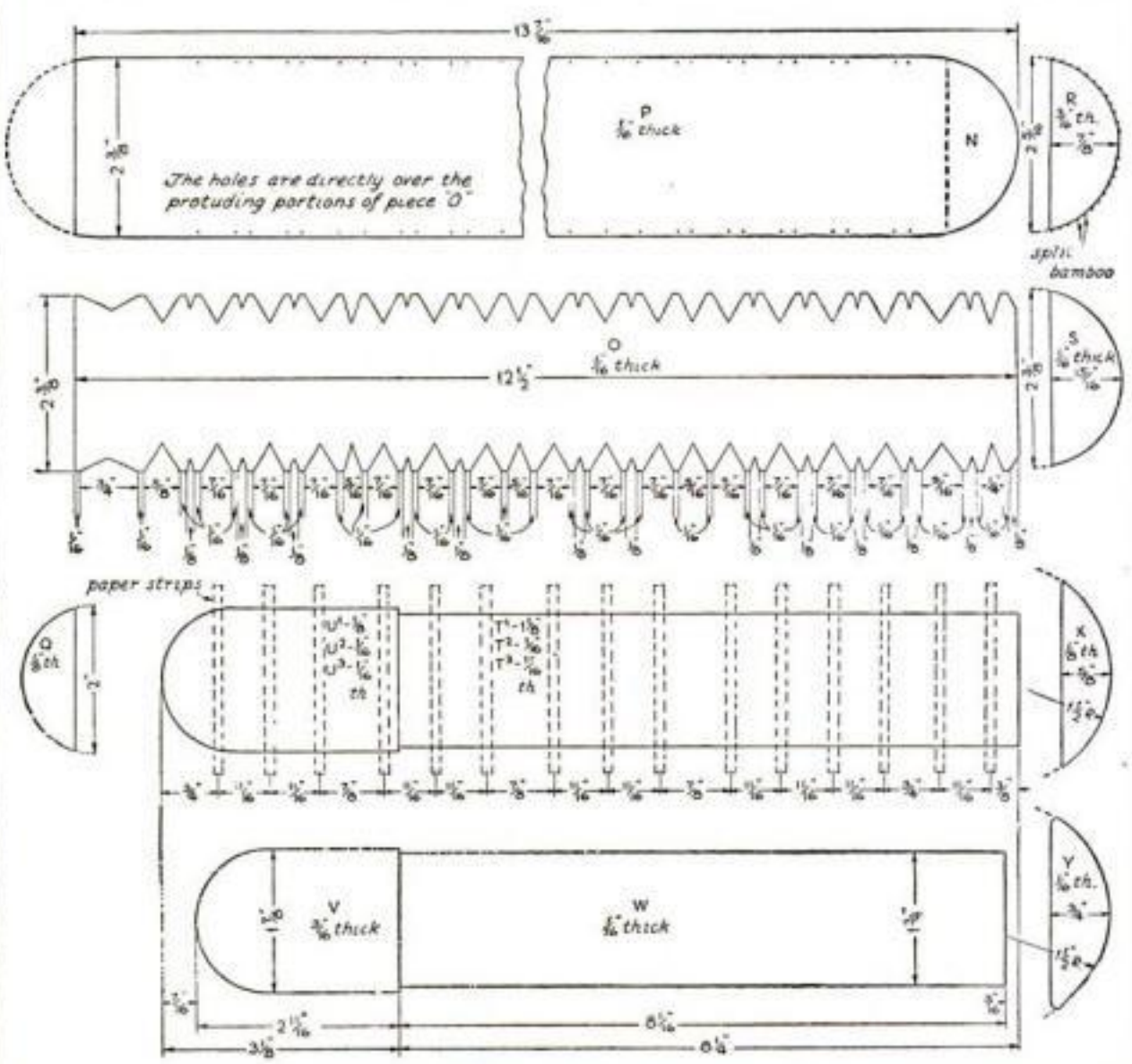


Fig. 3. How to shape superstructure units. The scale is the same as for drawings on pages 58 and 59

MODEL OF *NORMANDIE*

(Continued from page 76)

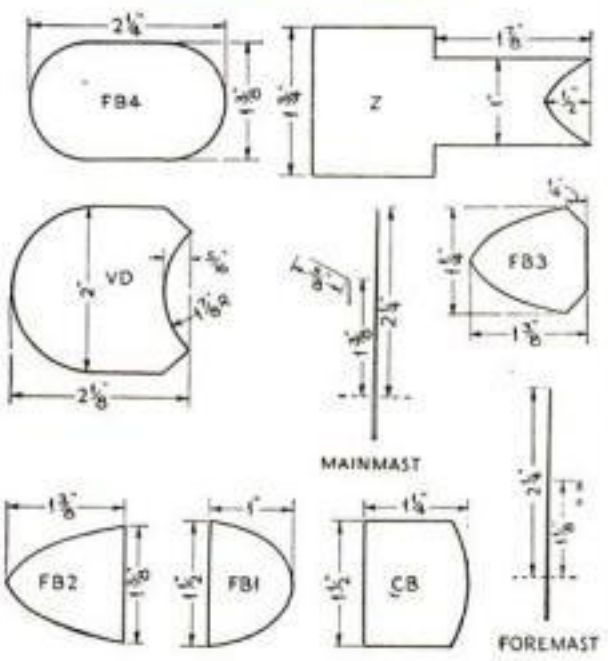


Fig. 4. How to lay out the seven top-deck housings and make the foremast and mainmast

long, and the third, 1 in. long.

The masts are long needles or wire. The foremast has a small piece of round wood for a crow's nest. A short wire fastened with liquid solder or heavy glue forms the gaff for the mainmast.

Above the water line, the sides of the hull unit are painted a semiglossy black; and below the water line, red. Only the portions of the deck at the stern that will remain exposed are to be painted buff. The edge of *I* and *J* should be white. The inside of the swimming pool needs a touch of blue-green for water, or colored paper may be glued on.

The side edge of *E* is painted white, all around. The whaleback and breakwater *M* are also painted white. The decks aft of the breakwater and the derrick booms are buff, as is the exposed portion of the deck aft. After the paint is dry, a small piece of white card is fastened to the deck forward, between the derrick booms, for a hatch cover. The false sheer is now painted on the edge of *E*, starting at a point about opposite the derrick booms, until the black paint covers the full thickness of *E* at the bow.

The entire superstructure is first painted white. The wings of the captain's bridge *(Y)*, and the top of FB^1, FB^2, FB^3, FB^4, and *VD* are then painted buff. The masts are brown, and the funnels vermilion, with a black band ¼ in. wide at the top.

When the paint has dried thoroughly, the model can be assembled. Deck *E* is glued to the hull unit. The superstructure unit can then be glued and nailed to *E*. The nails should be placed where they *(Continued on page 79)*

Bow view of the model. Even in a small model, the ship gives an impression of immense size

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NO MATTER how much or little time you have for your home workshop activities, it pays to concentrate your efforts on worth-while projects. To help you do this, we offer a series of blueprints for models, furniture, radio sets, toys, and other projects. The following list gives a wide selection, but many other prints are available. Send a stamped and addressed envelope for a complete list.

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IF YOU want a light boat that folds up and therefore can easily be carried by automobile, build our little duck boat. It is 13 ft. long, weighs about 70 lb., and is unusually stanch and stable. While it is intended to be paddled, oarlocks can be added for rowing or a canoe sail rigged up for sailing. Blueprint and instructions, 50 cents . . . with full-size patterns, $2.00. Order Blueprint No. 170-R.

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*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R* 1.00
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Marconi Rig with Jib for Above, *133-A* ..... .25
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Log Cabin, Three-Room, *134-R* ..... .50
Projector for Photos and Pictures, *259A* ..... .25
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Chests, Treasure, *78* ..... .25
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Floor Lamp with Tripod Base, *243A* ..... .25
Magazine Rack, Ladder-Back Style, *250A* ..... .25
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Lamps, Modern (no turning), *93* ..... .25
Sewing Cabinets, Two, *31* ..... .25
Silverware Chest on Stand, *256A* ..... .25
Table, Four-Leaf Card, *239A* ..... .25
Table, Tavern, and Scroll Mirror, *105* ..... .25
Tea Wagon, *13* ..... .25

SHIP AND COACH MODELS

(Construction kits are available for some of these models. See page 88.)

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R* ..... .75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200* 1.00
Bottle, Clipper Ship in, *121-122* ..... .50
Civil War Ships *Monitor*, *Merrimac*, and *Hartford* (3½, 5⅜, and 5⅛ in. long respectively), *258* ..... .25
Clipper Ship (20½-in. hull), *51-52-53-R* 1.00
Clipper, Simplified (9¼-in. hull), *219* ..... .25
Constitution (21-in. hull), *57-58-59-R* 1.00
Cruiser *Brooklyn* (8-in.), *236* ..... .25
Cruiser *Tuscaloosa* (11¾-in.), *234* ..... .25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R* 1.00
Galleon *Revenge* (25-in.), *206-207-208-209* 1.00
Hartford, Farragut's Flagship (33¼-in. hull), special prints *221-222-R* 1.50
H. M. S. *Bounty* (8½-in. hull), *254* ..... .25
Mayflower (17½-in. hull), *83-84-85-R* 1.00
Motorboat, 29-in. Cruiser, *63-64-R* ..... .75
Motorboat, Working Model (20-in.), *196* ..... .25
Liner—*Aquitania* (9-in.), *225* ..... .25
Liner—*California* (12½-in.), *251* ..... .25
Liner—*Normandie* (20⅜-in.), *264-265* ..... .50
Liner—*Manhattan* (12-in. long), *204* ..... .25
Liner—*St. Louis* (11-in.), *231* ..... .25
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R* 1.00
Santa Maria (18-in. hull), *74-75-76-R* 1.00
Show Boat, Illuminated (14-in.), *263* ..... .25
Stagecoach with horses, *144-145-146-R* 1.00
Steamboat, *Mississippi* (19½-in.), *94-95-96-R* 1.00
Steamships *Savannah* (3 in. over all) and *Atlantic* (6 in.), *235* ..... .25
Trading Schooner (17¼-in. hull), *252-253* .50
"Treasure Island" Ship *Hispaniola* (7-in.), *237* ..... .25
Viking Ship, (20½-in.), *61-62-R* ..... .75
Whaler—*Wanderer* (20½-in.), *151 to 154* 1.00
Yacht *Rainbow* (7½-in. hull), *233* ..... .25
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Yacht (20-in. racing), *48-R* ..... .50

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All-Wave Portable (battery), *217-R* ..... .50
Amateur Short Wave Receiver, *155* ..... .25
Amateur Radio Transmitter, *183-184* ..... .50
Amplifier, Three-Stage Audio-Frequency, *42* .25
Five-Tube Short Wave (A.C. or D.C.) *223* .25
Full Electric Headphone Set, *130* ..... .25
One Tube (battery operated), *103* ..... .25
Screen-Grid Set, *109* ..... .25
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FLYING AIRPLANE MODELS

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S. E. 5a World War Plane, 30-in., *168-169* .50
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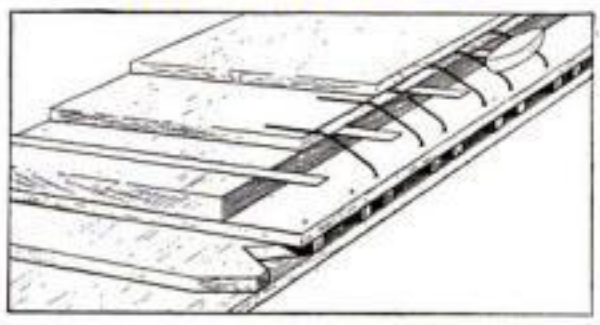
MODEL OF *NORMANDIE*

(Continued from page 77)



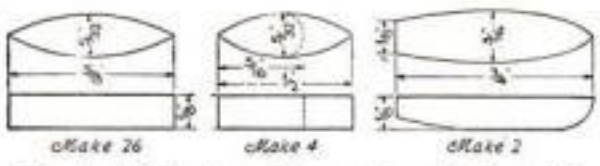


Fig. 5. Lifeboats and two streamlined ventilators, and sketch showing lifeboat supports

will be covered by the funnels. Since the superstructure is wider than the hull, it overhangs 1/16 in. on each side. Care must be taken to make the overhang even. The funnels may then be glued in position, the second and third being farther apart than the first and second.

The masts are finally inserted into holes previously drilled and then bent with pliers at the base into the proper rake.

List of Materials

WHITE PINE, BASSWOOD, OR BALSA

No. of Pieces	T.	W.	L.	For
1	¼	2¼	24	A*
4	3/16	2¼	24	B, C, D, E, and V
3	1/16	2⅛	24	N, O, and P
2	⅛	1⅞	24	U^1
1	1/16	1⅞	24	U^2 and U^3
1	⅛	1¾	24	T^1
1	1/16	1¾	24	T^2, T^3, and W
1	⅞	1¼	6	Funnels
1	5/32	⅜	12	Lifeboats

NOTE: The remaining pieces are to be cut from scraps left over.

MISCELLANEOUS

1 pc. 1/6-in. half-round split reed about 2 in. long for edge of swimming pool.
2—2¾-in. needles for masts.
3 ft. thin stiff wire for davits and gaff.
1 ft. fine split bamboo for window frames.
5-in. length of 1/16-in. dowel for derrick booms.
Small piece of thin cardboard for anchors and hatch cover.
Glue.
Black, white, red, brown, and buff paint (or use black, white, red, and buff, and mix them to make brown).
*For full-hull model, substitute a block 1 by 2¼ by 24 in. for piece A.

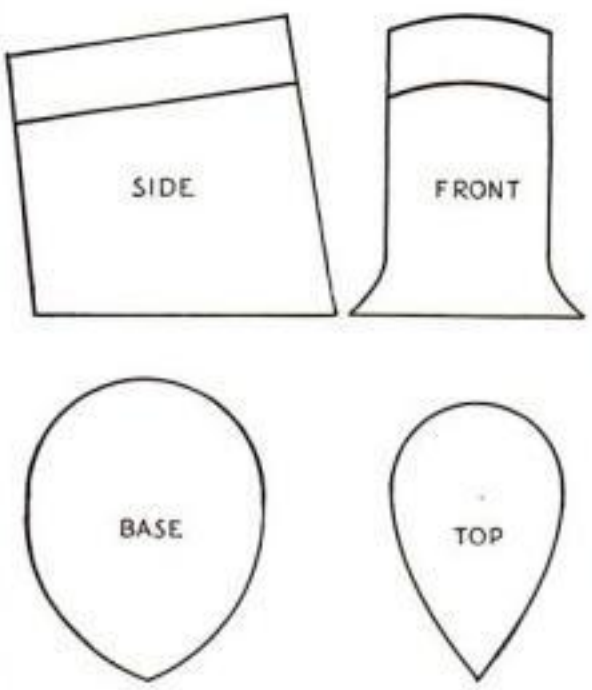


Fig. 6. The funnels are so peculiar that these four views have been drawn full size

ROOMY Knitting Bag

DESIGNED TO STAND BESIDE CHAIR

By Herman Hjorth

The bag, which folds up for carrying, is large enough to hold the knitting, yarn, and needles

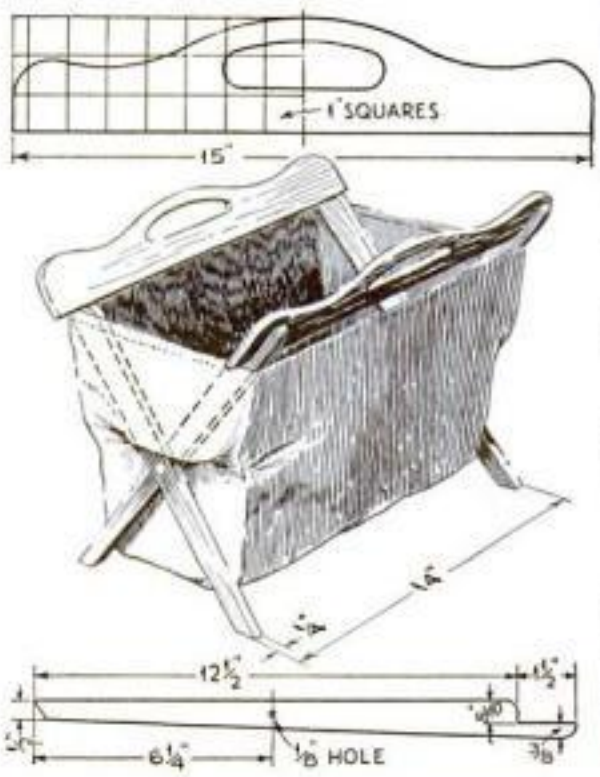
FOR any woman who has been attracted by the present vogue for knitting, a convenient knitting bag of the type illustrated forms a desirable and always welcome gift. This bag is fastened to a wooden frame mounted on trestle legs so that it can stand on the floor beside a chair. It is large enough to hold a good-sized piece of work, together with long needles and a ball of yarn. The ball remains in the bag while the knitting is being done.

Frame and legs are of ¼-in. stock. The two pieces for the handles may be sawed to shape with a coping saw. Cut the opening for the hand before sawing the outside shape. Small holes spaced about 1 in. apart are bored along the lower edges. They should be just large enough to enable a needle to be passed through when the material is sewed to the handles. A 1½-in. brad fastened in a hand drill may be used for boring the holes instead of a regular drill. The head is cut off the brad and the end filed to a flat chisel point.

The legs are sawed and planed to shape, and joined with small bolts 6¼ in. from their lower ends. The handles are fastened to the legs with glue and a couple of small brads.

The wooden frame may be stained and finished with three or four coats of very thin shellac. The shellac is rubbed down between coats with No. 2/0 steel wool. The last coat may be rubbed with powdered pumice stone and crude oil to a smooth, satiny finish.

The bag is now made and sewed to the handles. It covers the upper part of the legs, but their lower ends are put through a slit in the bag just above the point where they are joined.

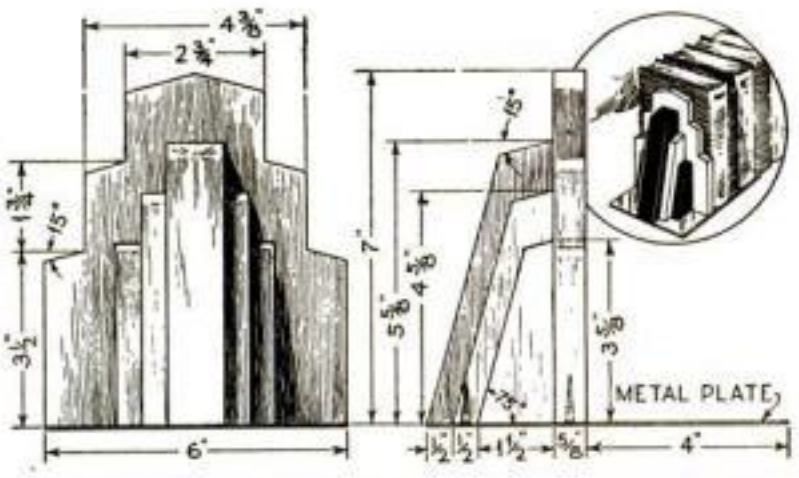


How to lay out and assemble the four wooden parts, which are sawed from ¼-in. stock

MODERN BOOK ENDS MADE FROM SCRAPS

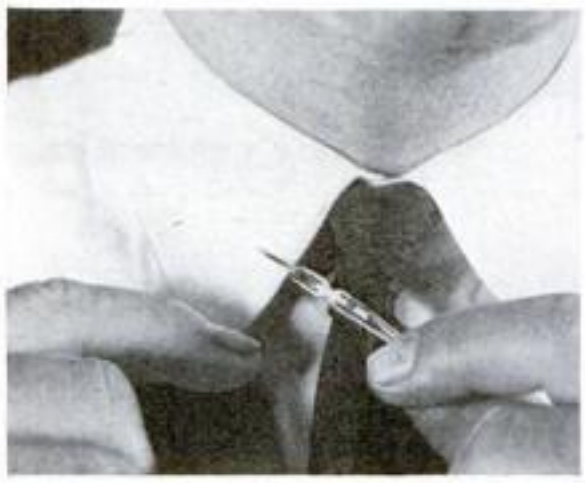
THESE attractive book ends may be made from any pieces of scrap left over from other jobs. Different kinds of wood may be used in the same book ends.

It is recommended first to saw and plane all the pieces to dimensions. The five small pieces at each end should then be glued side to side as a unit. Each unit is smoothed with a plane and glued to the 6 by 7 in. boards. The whole assembly is next placed on a metal plate and its outline scratched with a steel point. Each plate is sawed to this shape with a jeweler's saw, filed smooth, and fastened with three flat-head screws to the wood as shown, after which a piece of cloth or felt is glued to its underside. The glue should be applied to the metal and not to the cloth.



The book ends may be finished as desired. If made from different kinds of wood in such a way as to give a pleasing color contrast, no stain should be applied.—H.H.

DURABLE COLLAR HOLDER CUT FROM ONE PIECE



This neat collar holder is cut and formed from spring brass and then chromium plated

ALTHOUGH homemade, this collar holder equals in appearance and surpasses in durability the average commercial article. The writer has used it for the past two years and finds no perceptible loss in gripping power.

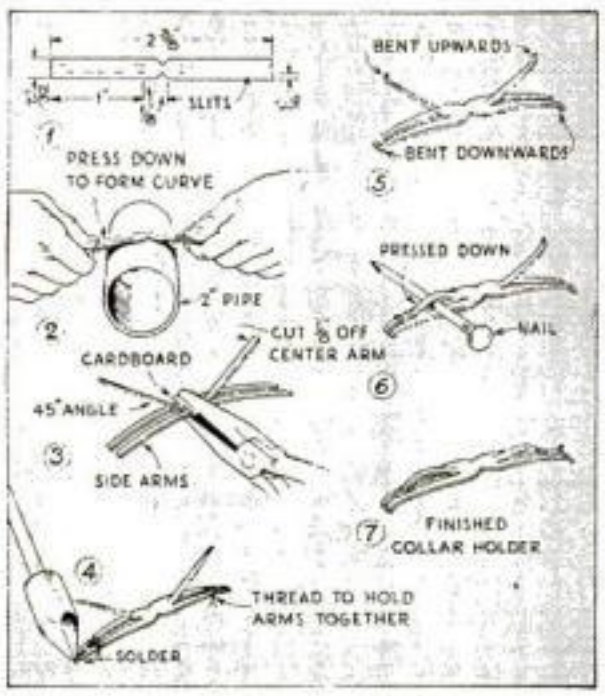
It is made from a piece of 18-gauge spring brass 7/32 in. wide and 2⅜ in. long. Two saw cuts are made from both ends of this piece with a jeweler's saw according to the dimensions given in the drawing. The central V-shaped design is then filed.

The metal is bent to the desired curvature by pressing it against a 2-in. pipe. It is then held in the center with a pair of pliers while the central parts between the saw cuts are bent upwards at an angle of about 45 deg. Place a piece of cardboard over the metal to prevent the pliers from marring its surface. Cut ⅛ in. off the length of each central piece.

The upraised center arms, as well as the curved side arms, are now tapered with a file and smoothed with fine emery cloth. The side arms are forced together by wrapping cotton thread around them. When the ends are about 1/16 in. apart, they are joined with soft solder. The joined side arms are then bent downwards ¼ in. from their ends. The upraised center arms are bent upwards ⅛ in. from the end, as shown in the drawing.

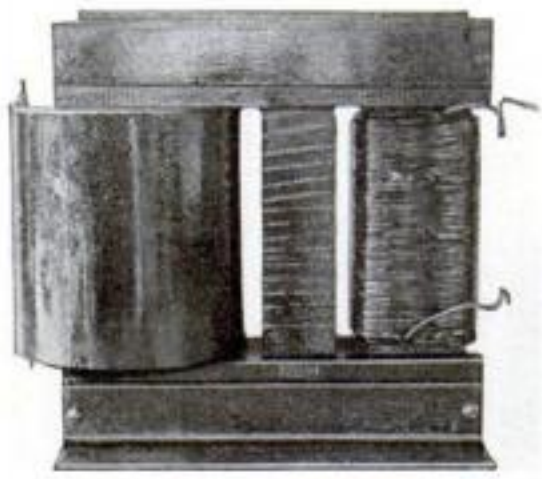
A nail about ⅛ in. in diameter is placed across the side arms and against the center arm. The latter is then bent down over the nail as far as it will go. After the nail has been removed, the center arm is pressed down until its bent end goes into the opening between the joined side arms. Repeat on the other side.

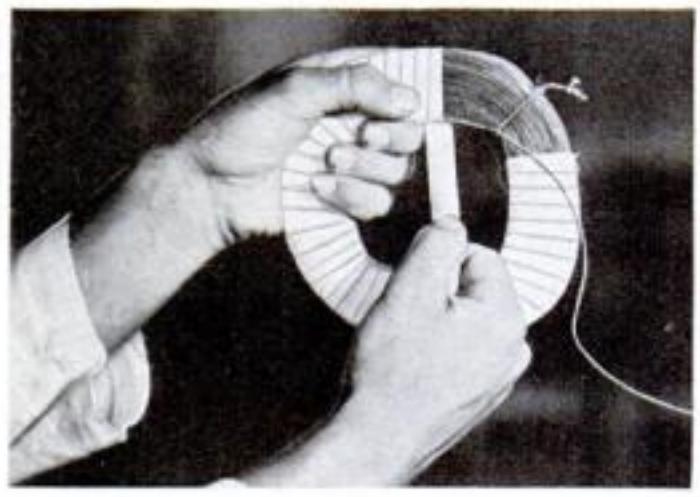
After a final smoothing with emery cloth, the collar holder should be chromium or gold plated. You can have this work done at a reasonable charge by any professional electroplater.—MYRON FLEISHMAN.



Step-by-step sketches showing how to cut out, bend, solder, and finish the holder

BUILDING A 12,000-Volt Transformer





Left: A transformer for high-frequency experiments. *Above:* Wrapping tape around a coil of the secondary

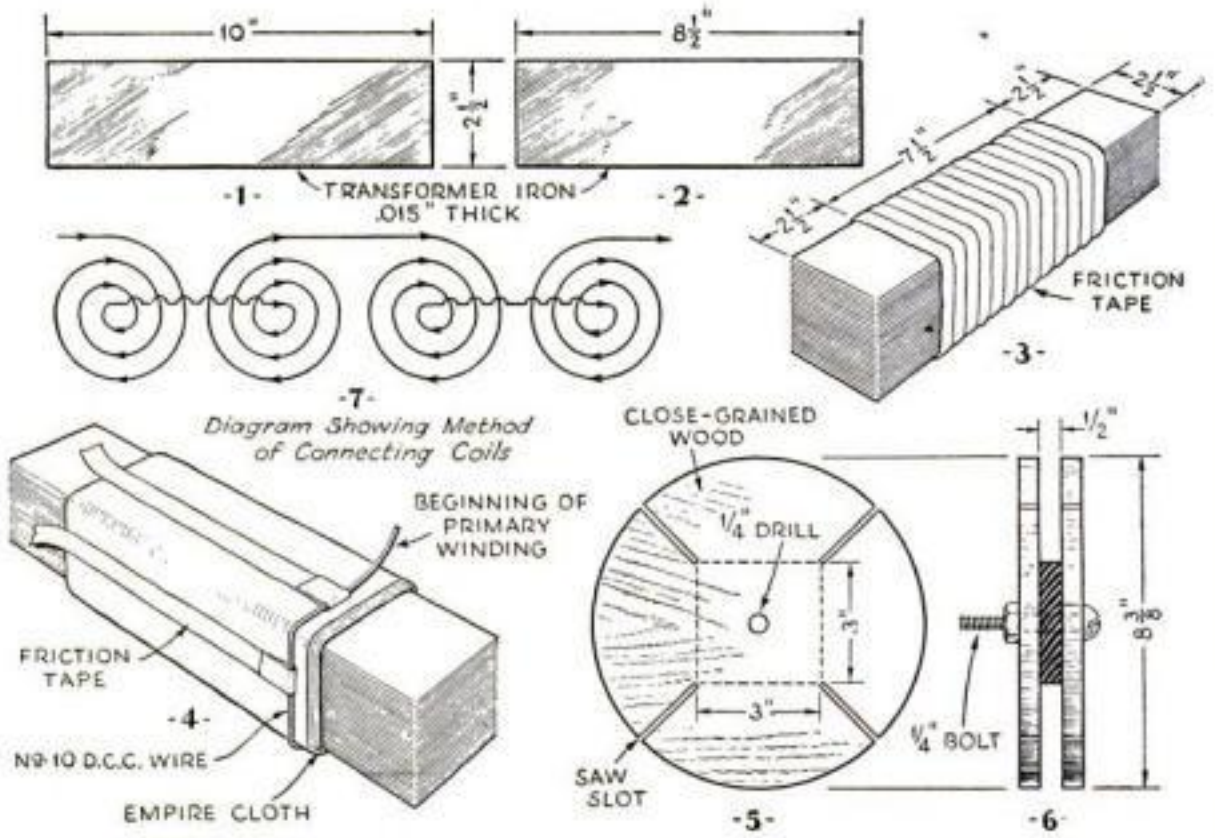
By KENDALL FORD

TO PRODUCE spectacular displays with the high-frequency coil described in the previous article of this series (P. S. M., May '35, p. 82), it should be used with a transformer having an output of from 10,000 to 12,000 volts and a capacity of not less than one kilowatt. The transformer illustrated was designed especially for that coil and has sufficient output to energize it to its full capacity.

Cut 332 pieces of transformer iron, .015 in. thick, to the size shown at Fig. 1, and the same number of pieces to the size shown at Fig. 2. If a different thickness is used, cut enough to make one stack of each size 5 in. high when pressed closely together. Make a box for stacking the core, 12½ in. long and 2½ in. wide. Alternately place the longer pieces of iron in the box until one half of the total number are so placed. Remove the pieces carefully from the form and tape with friction tape, as shown in Fig. 3. Detailed information on stacking transformer cores was given in a previous article (P. S. M., June '34, p. 80). Assemble and tape the remaining half of the large pieces of iron. Wrap each assembled section of the core with empire cloth, or varnished linen, 7½ in. long and to a thickness of ¼ in. Place a strip of friction tape, 10 in. long, over the empire cloth on each side of the core, allowing each to extend 1¼ in. beyond the edge of the empire cloth.

The core is now ready for the primary winding. Beginning ¼ in. from the edge of the empire cloth, wrap a turn of No. 10 D. C. C. wire and fold the end of the friction tape over the wire, as shown at Fig. 4. Wrap the next turn of wire over the folded portion of tape and continue winding to ¼ in. from the edge of the empire cloth at the opposite end of the core. Fold the ends of the tape back over the winding and place four more 10-in. strips of friction tape over the winding. Begin winding the second layer of wire over the first layer and when the first turn is in place, fold back the ends of the tape, as was done with the first turn of the winding. Continue winding as outlined above until a total of 344 turns have been wound upon the core. The thicknesses of empire cloth may seem to be excessive insulation for a voltage of 110, but its main purpose is to protect the primary from breakdowns due to high-voltage surges from the secondary.

For the second- *(Continued on page 83)*



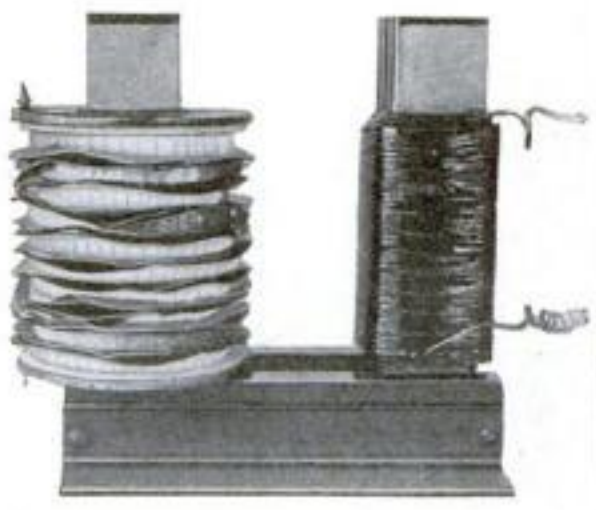
The two sizes of transformer iron used; how they are taped after being stacked; starting the primary winding; form for winding secondary sections; and how secondary coils are connected

BUILDING A 12,000-VOLT TRANSFORMER

(Continued from page 82)

ary windings it will be necessary to make a wooden winding form, as shown at Figs. 5 and 6. The form consists of two 8⅜-in. wood disks, with a 3-in. square center secured to one of the disks, as shown in Fig. 5. Close-grained wood should be selected for the form, so that there will be no rough edges at the saw slots. The form is held together with a ¼-in. bolt, the end of which may be placed in a lathe or the chuck of a hand drill for winding. Before beginning to wind a section, pieces of small wire about 8 in. long should be placed in the saw slots, and the square center of the form wrapped with several layers of paper, ½ in. wide.

In winding the sections of the secondary, either No. 29 S. C. E. or No. 32 D. C. C. wire may be used. Approximately 17 lb. of the No. 32 wire or 24 lb. of No. 29 will be required. If the winding form is made to the exact size shown in the drawing, it can merely be wound until the wire is up to the



Transformer with ten secondary sections in place ready to receive remaining core pieces

top of the form, without counting the turns. Approximately 38,000 turns of wire will be required for the whole secondary, and since there are to be ten sections, 3,800 turns will be wound on each section.

The form may be wound in a lathe or the chuck of a hand drill, but no attempt should be made to hurry, since several hundred turns may be lost by uneven winding. After each section is wound, the tie wires should be tied around the coil and the form taken apart. The strip of paper around the center of the form may now be removed and the coil carefully lifted away from the form. Let the coil soak in hot paraffin for several minutes, then carefully remove it and place it on a sheet of paper on a flat surface. When the paraffin is hard, remove the paper and tie wires, and tape the section with linen tape, allowing the tape to lap one half its width.

Bring the leads out of the coil between turns of the tape so that one lead will be on the inside diameter of the coil and one on the outside, each lead being in a vertical line with the other. Mark an arrow on the tape near each lead to indicate the direction of the winding. After the coil is taped, it will be somewhat thicker than the form upon which it was wound, due to the paraffin that was absorbed in the insulation. Allowance for this increase was made in calculating the core space.

Cut two circular pieces of fiber, ¼ in. thick and 8 in. in diameter, and cut a hole 3 in. square in the center of each. These pieces are to serve as end pieces and terminal supports. Drill a 5/32-in. hole in each for the terminal screw near the outside edge. Cut 36 pieces of empire cloth the same size and shape as the fiber end pieces, and enough pieces of cardboard to make (Continued on page 84)

BUILDING A 12,000-VOLT TRANSFORMER

(Continued from page 83)

a stack ½ in. high. Join the two taped sections of core together at one end with the short pieces of transformer iron, shown in Fig. 2. Clamp the core together with pieces of angle iron and ¼-in. bolts. The core is now ready for the secondary sections.

Place a fiber end piece over the core so that the terminal will be on the outside. Since it is not advisable to let the secondary sections come any closer than ½ in. from the end of the empire cloth on the core, it will be necessary to place a number of the cardboard spacers next to the fiber end pieces before placing the first section. The secondary sections should be so arranged on the core that the winding of each will be in an opposite direction to that of the preceding coil. After the first coil is in place, four sections of empire cloth should follow; then place another coil. Connect the inside of the first coil to the inside of the second coil, making the connection as short as possible, and solder with rosin as a flux. Place the connection between the two layers of empire cloth and press the coil into place.

PLACE the third coil on the core so that the winding is opposite to the second coil and connect the top wire with the top of the second coil. Connect the remaining coils as outlined above. The coil connections are shown at Fig. 7. It will be seen that with the coils arranged alternately on the core, with reference to the direction of the windings, the current will flow in one direction around the core.

After all of the coils are in place and connected, put the cardboard spacers and fiber end piece over the core and insert the remaining core pieces. One photograph shows the transformer with the secondary sections in place, ready to receive the remaining core pieces. Clamp the end of the core together with pieces of flat iron and ¼-in. bolts. Connect the two ends of the secondary coils to terminal screws and cover the whole secondary with a piece of thin fiber or cardboard.

In order to prevent arcing at the spark gap and increase the efficiency of the transformer, the design includes a magnetic leakage section, which is placed between the primary and secondary as shown in a photograph. The section consists of enough pieces of transformer iron, 2 by 7½ in., to make a stack 2½ in. high, securely taped together. The section is made removable so that the builder can note the effect with and without the section in place. To avoid breaking down the insulation, it is always advisable to provide a temporary gap across the secondary, not greater than ½ in., when testing the transformer.

COPPER SULPHATE GIVES ZINC A BLACK COLOR

ARTICLES of zinc can be given a dense, dead-black color by applying a saturated solution of copper sulphate. Thoroughly clean the zinc first. The black will be durable after it is dry. This method is particularly useful for blacking etched zinc name plates. Polish the blacking from the letters, and wax the background if you wish it to have a shiny, instead of dead-black, appearance.—C. L.

TAPE PROTECTS INSULATION FROM HEAT OF BLOWTORCH

WHEN attaching soldering lugs to wires and cables with a blowtorch, the insulation nearest the end of the conductor can be protected from burning by first serving the end of the conductor with three or four layers of friction tape for a length of about 2 in.—L. N. G.

KNOT-WORK SLIPPERS FOR MANY USES

(Continued from page 65)

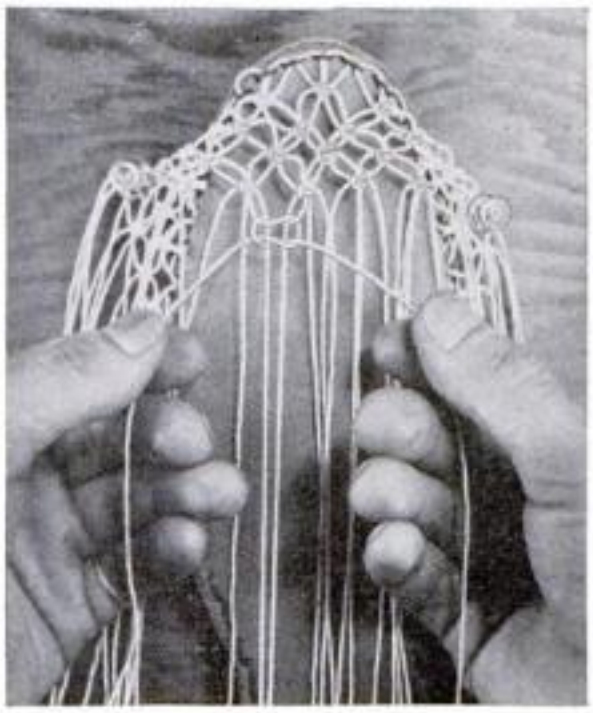


Fig. 6. The work is held with pushpins on each side while the center knots are tied

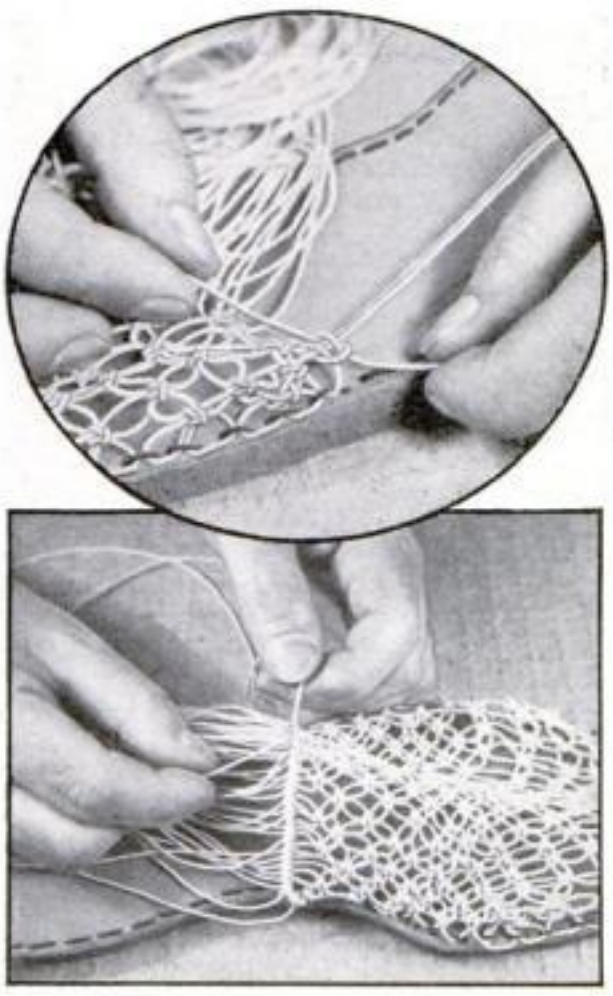


Fig. 7. The upper photo shows how the sides of the uppers are anchored to the stitching after the twenty cords have all been knotted. The uppers are finished (lower view) with a row of half-hitches made with the loose cords over a single cord brought across the instep

which will hold the stitching securely, is thick, waterproof casein glue. Spread this in a thin film on the bottom of each sole, making sure that each stitch becomes soaked with it. Press each sole into contact with a piece of light leather, and weigh them down for twenty-four hours until the glue has completely set. The excess leather is then trimmed off with scissors or a razor blade.

If you wish cool outdoor shoes that will stand more than the usual wear, use lightweight leather for the soles, instead of sponge rubber. After the uppers are knotted, cement a pair of ten-cent composition half soles in place, and attach a pair of rubber heels.

SUBSCRIBERS *are requested to notify us of change of address four weeks in advance of the next publication date.*

POCKET CHART AIDS IN WEATHER FORECASTING

(Continued from page 61)

back and make a heavy paper envelope in which to keep the chart.

Take daily readings of the barometer to know whether it is rising or falling, and note in a general way how the wind blows.

To use the chart, turn the disk until the proper wind-direction and barometer indications show in the two upper windows. In the lower window numbers appear. Choose the one suiting the conditions, and read on the back the forecast corresponding to it.

For instance, suppose that the wind sets in between southwest and northwest, and the barometer, rising rapidly, stands between 30.1 and 30.2 in. No. 2 turns up: "Fair, followed within 2 days by rain."

Suppose, again, that the wind is from east to northeast, with the barometer at 30.1 (or above, as indicated by the upward-pointing arrow in the chart), and falling slowly. This reads as No. 9.

By taking daily weather notes you can soon discover the important variations of these rules peculiar to your locality. If you live on the west coast, the meaning of wind and barometer readings will be somewhat different from that of readings taken on plateaus east of the Rocky Mountains. Little rain or snow is to be expected within a low-pressure area over Idaho where the winds, purged of moisture by the mountains, have blown over rather dry areas, although the wind-barometer signs are much the same as those noticed when the storm is west of the Cascades, fresh from a trip over the Pacific Ocean. When this same center of disturbance has moved over the Mississippi Valley, winds laden with moisture from the Great Lakes and the central valleys spiral toward it, and rainfall begins to increase in the eastern side.

FORECASTS

1. Fair, with slight temperature changes, for 1 to 2 days.
2. Fair, followed within 2 days by rain.
3. Continued fair, with no decided temperature change.
4. Slowly rising temperature and fair for 2 days.
5. Rain within 24 hours.
6. Wind increasing in force, with rain within 12 to 24 hours.
7. Rain in 12 to 18 hours.
8. Increasing wind, and rain within 12 hours.
9. In summer, with light winds, rain may not fall for several days. In winter, rain within 24 hours.
10. In summer, rain probable within 12 to 24 hours. In winter, rain or snow, with increasing winds, will often set in when the barometer begins to fall and the wind sets in from the NE.
11. Rain will continue 1 to 2 days.
12. Rain, with high wind, followed, within 36 hours, by clearing, and in winter by colder.
13. Clearing within a few hours, and fair for several days.
14. Severe storm imminent, followed, within 24 hours, by clearing, and in winter, by colder.
15. Severe northeast gale and heavy precipitation; in winter, heavy snow, followed by a cold wave.
16. Clearing and colder.

THE NATIONAL HOMEWORKSHOP GUILD

(Continued from page 69)

the lion had to be done between the bars of the cage, and he left the figure attached to several bars at the rear so that it would not shift around. The completed piece is probably the most elaborate variation of the old and well-known ball-and-cage whittling stunt that has ever been made.

That Mr. Stenwick is equally good on straight cabinetmaking is shown by his pioneer cabinet, illustrated on this page. The carved panels on the door show, first, a buffalo hunt by Indians; second, a covered wagon; and third, a farm on the edge of the prairie. In the circular panel at the top is a woman spinning, to represent the early pioneer home. In model making, Mr. Stenwick is similarly proficient. His Viking ship, almost entirely carved from solid wood instead of being built up, was regarded by the judges as one of the most decorative models in the display. He sums up his home workshop philosophy very simply: "There is real satisfaction in tackling a hard job and making a go of it. That is why I have kept at it all these years."

Carved pioneer cabinet by A. O. Stenwick, of Red Wing, Minn.—second prize for hand-made furniture

Brass and copper jewel casket by W. Sovich, of Chicago—second prize in decorative metal

The following new clubs have been granted charters since the June issue was published: LeRoy Homeworkshop Club, LeRoy, N. Y.; Niagara Homeworkshop Club, Niagara Falls, N. Y.; West St. Louis Homeworkshop Club, West St. Louis, Mo.; Crown City Homecraft Club, Pasadena, Calif; Freeport Craftsman's Guild, Freeport, N. Y.; Ottumwa Craft Club, Ottumwa, Iowa.

Several local clubs have sent in unusually interesting photographs of their local exhibitions. These are being retained for publication as soon as space is available.

Clubs looking for a project that will have some civic value may be able to make use of a suggestion offered by a reader in St. Paul, Minn. "Would it not be a good idea," he wrote, "if one or more of the clubs would make up a set of ship models, such as those in your Popular Science Model-of-the-Month series, and present them as a permanent exhibit to the town library or one of the schools? A small brass plate with each exhibit could give credit to the club and, if desired, the individual members who contributed their work."

CLUB ACTIVITIES

Greater Lawrence (Mass.) Homeworkshop Club. At a large exhibition held in a hardware store, the Popular Science Craftwork Medal and a purchase order for tools were awarded to Ernest Dugarden for brass turnings. Robert Zeiner won second prize for an inlaid fern stand, and William Hilbert third prize for an inlaid smoking stand. . . . The idea of holding an exhibition for all the clubs in New England is gaining strength.

Newcastle (Calif.) Homeworkshop Club. Prizes were awarded as follows at a club exhibit given in the window of an Auburn lumber company: first, P. F. Hirsch, for a duck pool; second, Mr. Hirsch, for the silhouettes of four wild horses; third, Emile Saladana, for a garden goose.

Mount Vernon (N. Y.) Homeworkshop Club. Herman Hjorth, a regular contributor to POPULAR SCIENCE MONTHLY, recently gave a wood-turning demonstration before the club at the Edison High School. Albert Constantine also gave a *(Continued on page 87)*

Some of the numerous models. Near the center can be seen the steam threshing engine model of Edwin J. Davis, Rockford, Ill., which won second prize for model making

HOMEWORKSHOP GUILD

(Continued from page 86)

talk on veneers and how to use them.

Yakima (Wash.) Homecraft Club. The second annual exhibit and contest sponsored by the Yakima Club was held in the display room of the local power and light company. More than 250 articles were entered. The Popular Science Craftwork Medal and the grand prize, a scroll saw, were won by George Raichle. His entry was a tea wagon. There were forty-five prizes in all.

Capital Homecraft Club, Washington, D. C. A summer exhibition will be held in a store window in the business section of Washington. . . . An exchange and barter department has been established under the management of C. T. Kingsbury, the member who suggested the idea.

Springfield (Mass.) Homecraft Club. A large, well-attended exhibition was held in the Junior Achievement Building. C. A. Denham was awarded the Popular Science Craftwork Medal for a hand-carved plaque of Abraham Lincoln. Second prize for the best exhibit in the show went to Walter Presnel for a sailboat model.

Lincoln (Nebr.) Homeworkshop Club. At the second annual exhibition and contest, Robert Dyer won the local sweepstakes prize.

Topeka (Kans.) Homeworkshop Club. George F. Gladfelter is about to start a new show-card class of twenty members. . . . A film furnished by Bausch & Lomb was shown at a recent meeting of the photography class, which was attended by more than seventy-five members and friends. . . . Plans are being formed for starting a class in radio.

Manchester (N. H.) Homeworkshop Club. More than 125 members and guests attended a recent demonstration at a local hotel. A complete set of home-workshop machinery was on display, and demonstrations in lathe work were given by W. B. McIlvie. Frank R. Smith, of the manual training department at Central High School, gave a talk on furniture and furniture design. . . . Within three months the club has grown from thirty-six to eighty-three members.

Atlanta (Ga.) Homecraft Club. To aid in a membership drive, the club has had large posters painted and placed in a number of stores selling hardware, paint, and machinery. Cards are provided for passers-by to fill out and drop in a box near each poster.

San Diego (Calif.) Homecraft Club. Theodore T. Clemesha, who won first prize for veneering and inlaying and second prize for furniture made with power driven tools in the first National Exhibition of the Guild, has been giving talks to the club members on design, woodwork, and furniture finishing. . . . The club will hold an exhibition in June.

Chicago (Ill.) Premier Homeworkshop Club. Since this club won the grand sweepstake prize at the National Exhibition, the meetings have been crowded with prospective members and visitors. Officers of many Chicago hobby clubs were present at one meeting. New quarters will be required immediately, and a centrally located auditorium is under consideration.

Dunkirk (N. Y.) Homeworkshop Club. A late spring exhibit was held in a local hardware store.

Billings (Mont.) Homeworkshop Club. In the local Festival of Arts, sponsored by the Women's Club of Billings, the home workshop club was well represented and members won a number of prizes.

Brunswick (Me.) Homeworkshop Club. A demonstration of chip carving was given at a recent meeting by Warren Raynes of Yarmouth.

Three Rivers Home Workshop, Three Rivers, P. Q., Canada. A one-member exhibition of craftwork is held at the close of each meeting.

If you like POPULAR SCIENCE MONTHLY why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

New Kit Contains Materials for WHITTLING A WOODEN Sea Captain

No. 7. Whittled figure 5½ in. high

KIT G

KIT D

NO. 4

KIT E

KIT 2S—
U.S.S. *Preston*

HERE is something new in construction kits—one that contains materials for whittling a quaint and colorful wooden figure of an old sea captain, Skipper Sam'l. Anyone can do this type of work successfully. It is necessary only to follow the simple step-by-step instructions and drawings included in the kit. No previous experience in whittling or carving is required.

The skipper stands 5½ in. high. To give you a good start, each kit contains two blocks of the correct size. These are of specially selected softwood and have been sawed to the approximate shape. Two blocks are given so that you can practice on one. If you are reasonably careful, the first block will turn out well, and you can get two good figures out of the kit. The necessary paints are included. The price is only $1.50, postpaid.

Another new kit contains materials for building a 31½-in. model of a United States destroyer, the famous *Preston*. This is one of our standard ship models, and the kit has been prepared in response to many requests. The lifts are cut to shape and everything is provided, including four brass stacks, two anchors, belaying pins, brass bell, two flags, two propellers, and shafts.

Other available kits are described in the following list.

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer*, 20½-in....$6.90*
AA. Same with hull lifts sawed..... 7.40*
D. Spanish galleon, 24-in..... 6.45*
DD. Same with hull blocks shaped.... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 6.95*
EE. Same with hull lifts sawed..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 6.75*
GG. Same with hull blocks shaped.... 7.25*
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33½-in. hull..... 7.95*
LL. Same with hull lifts sawed..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape..... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull, with lifts sawed to shape..... 4.95†
Y. Trading schooner, three-masted, 17½-in. hull ..... 4.90†
2S. U. S. Destroyer *Preston*, 31½-in. hull, with lifts sawed; can be made either a decorative or a working model.....5.95*

KIT F—Materials for 12-in. model of *Manhattan*

KIT H—U.S.S. *Indianapolis*, with partly shaped hull

KIT Q

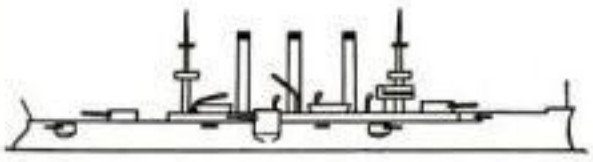
This is the privateer *Swallow*, a model with 12½-in. hull

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S. S. *St. Louis*, 11-in..... 1.00
P. Cup yacht *Rainbow*, 7½-in..... .75
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
S. S. S. *Savannah* (first steamship to cross Atlantic). 3½-in., and S. S. *Atlantic*, 6-in. (two models in one kit)..... .75
T. U.S.S. *Brooklyn*, armored cruiser in Spanish American War, 8-in..... .75



KIT T—U. S. S. *Brooklyn*

U. *Hispaniola*, the ship in "Treasure Island," 7-in..... .50
X. S. S. *California*, 12½-in..... 1.00
Z. H.M.S. *Bounty*, 11½-in..... 1.50
1M. Show boat, illuminated, 14-in..... 1.50

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble and stain included..... 5.75*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¾ in. high. Ready to assemble and stain included..... 5.75

No. 6. Solid rock maple butterfly table, top 19 to 22 in., height 22½ in. Ready to assemble and stain included..... 6.90*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high..... 1.50

NOTE: If you live west of the Mississippi River, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†). Otherwise all prices are postpaid anywhere in the United States. The kits marked with an asterisk or dagger will be sent C.O.D. upon request, but the purchaser will have to pay 28 cents additional upon delivery.

Popular Science Monthly,
353 Fourth Avenue, New York, N. Y.
Please send me Kit.....for
which I inclose $.....(or send C. O. D. ☐)

Name .....

Address .....

City..... State.....
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Remit by money order, check, or registered mail. No kits selling for less than $4.00 can be sent C. O. D. This offer is made only in the United States.

SKIPPER SAM'L—A WHITTLED FIGURE

(Continued from page 63)

outside the arms down to the elbows. Now saw up the outside of each leg *almost* to the bottom of Sam'l's coat (that is, within about ¼ in.) Then stop and saw up the fronts of his trousers legs until you meet the saw cut which marks the bottom of his coat. Finish the side cuts, and both legs are free.

Trim up the sides of the coat to the cuffs, and *down* (that avoids danger of splitting) from his elbows to his cuffs. Cut away a little at the bottom of the coat as you see in the side view of Fig. 1A. Now all that remains to be done is to slope Sam'l's chest. Measure down 1¾ in. from the point of the chin, and from this horizontal line sketch a liberal curve up each side to the inside end of the saw cut marking the chin. Cut away the wood outside this line with knife or saw, and your finished blank should look like Fig. 1B.

You'll see from Fig. 1C that we need a few more patterns. These patterns or templates are shown in Fig. 2. Lay them out on thin cardboard and cut them out accurately with scissors. Then take back template *A*, line it up at bottom and sides with the skipper's coat, and mark along the sides as in Fig. 3. This gives you the line joining his arms and body. Place and trace the sleeve template *B* on each arm in turn, lining up the bottom with the bottom of the cuff and setting the back edge (or the elbow) in about ⅛ in. from the back of the block, as in Fig. 4. Next align template *C* on the front of the block and draw up each side as in Fig. 5 to mark the line between arms and body.

Now sharpen your knife point and score deeply along the template lines you've just drawn. Keep forcing the knife point down and cutting away the little outer sections of wood until your block looks like Figs. 6A and 6B. This leaves the arms roughly shaped and standing out from the body (see also Figs. 7 to 10).

Let's start now on shoes and trousers. Study Fig. 7 carefully first. Fig. 1C will show you how the shoes look. Nick out the heels and round them off in back. Round off the blunt toe and slope the instep of each shoe. Cut out a sliver of wood all around each shoe to show the joint of sole and upper. Then take off the rough corners on each trousers leg, making a rough octagonal section tapering from the shoes toward the coat bottom. Cut *from* the shoes *toward* the coat to avoid splitting.

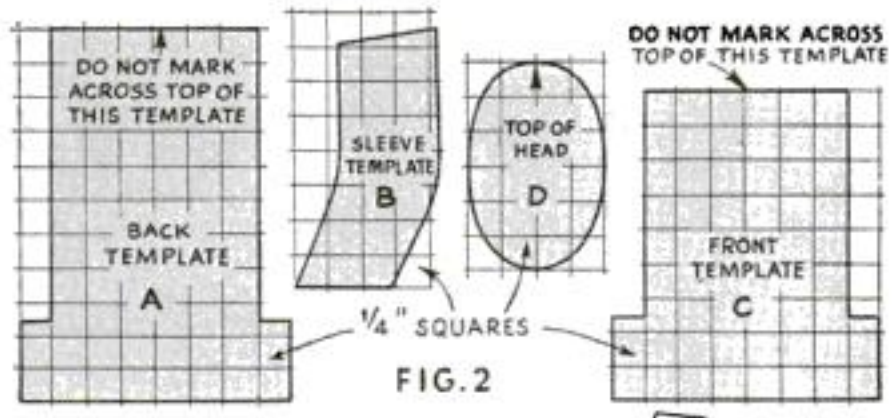


FIG. 2


FIG. 3


FIG. 4


FIG. 5

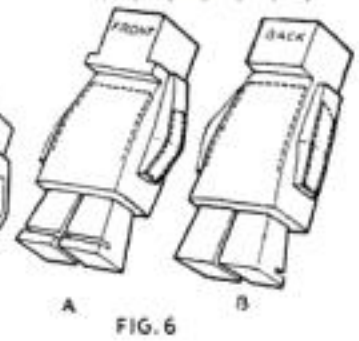


FIG. 6

Now measure down ½ in. from the top in back of the block, which is to become the skipper's head. Draw a horizontal line across the back of the block, and diagonal lines on each side to the top of the block at the front, as in Fig. 8. Cut this off. Put oval template *D* in place and pencil around it. Split off the outer corners to round the head as in Fig. 9. Shape the shoulders roughly as in Figs. 10A and 10B. Draw a line all around the head oval ½ in. down from the top, as in Fig. 9. This line marks the joining of cap and face, so

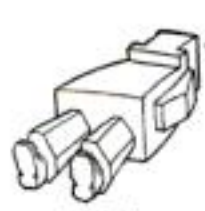


FIG. 7


FIG. 8


FIG. 9


FIG. 10-A


FIG. 10-B

with knife or small saw cut in about ⅛ in. deep all around it. Now split off the wood from below all around so that the block looks like Fig. 11A.

Your first step in whittling a face is to locate the nose. Draw a vertical line squarely down the front from the peak of the cap to the point of the chin. Measure down ⅜ in. from the joining of face and cap, and score 3/16 in. deep straight across the face on this line. This marks the tip of the nose. Now cut diagonally in from the point of the chin to the bottom of the scoring cut. Cut away the wood from the tip of the nose diagonally to the joint between face and cap at the same angle. The face will now look like Fig. 11E, with proper chin and nose slants.

Study Fig. 11F closely to fix the angles of chin, cheeks, and eyes before you make any more cuts. Mark a triangle for the nose as in Fig. 11B; then cut away at each side as in Figs. 11B, 11C, and 12A, about ⅛ in. deep. Now outline the cheek bones by cutting a line 1/16 in. deep, sloping downward each side of the nose (see Figs. 11C and 12A). Cut up from the point of *(Continued on page 91)*

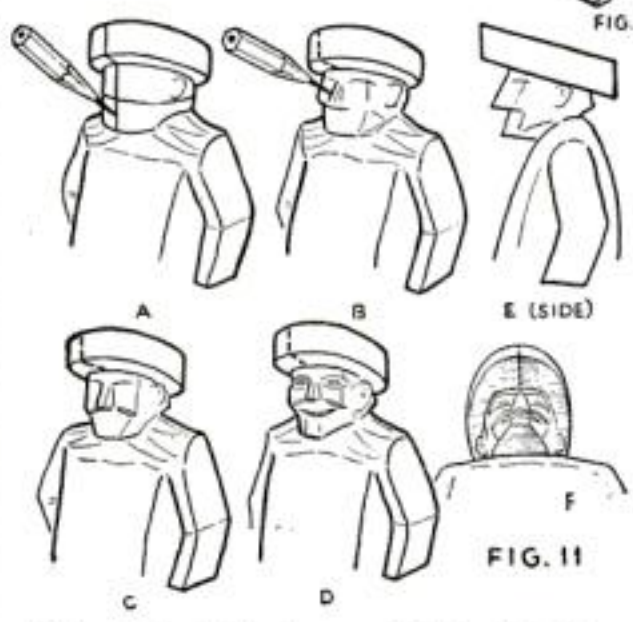


FIG. 11

When the body has been roughly blocked out, the head and features are shaped as shown

SKIPPER SAM'L—A WHITTLED FIGURE

(Continued from page 90)

the jaw to meet this line, and cut along each side of the face to form the jawbone, but don't cut up so far that you remove wood you'll need later for the ears. Cut a shallow slit for Sam'l's mouth squarely across the face (or tilting up a little at the corners, depending on how much grin you want him to have) and about 1/16 in. below the nose.

The eyes are started with notches as in Fig. 12B. They are about ⅛ in. deep and down

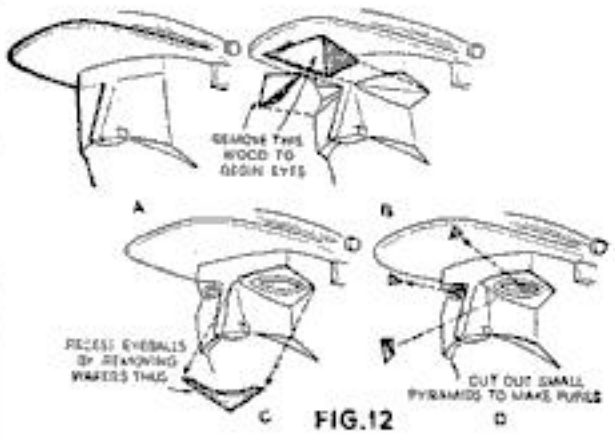


FIG. 12

The eyes are started by cutting two notches; then thin wafers are removed to form eyeballs

about ⅛ in. from the joint between face and cap. They start at the bridge of the nose and are deepest well out at the sides of the head. If you want to, cut out thin wafers as in Fig. 12C to form eyeballs, and make each pupil by cutting out a tiny triangle as in Fig. 12D; otherwise merely flatten out the base of the eye socket, then cut a slit like the mouth slit across it. Dig a little hole at the middle for the eyeball.

Next shape the cap as in Figs. 13A, 13B, and 13C, sloping in toward the head at the sides and back, and cutting in carefully above the cap visor in front. If you're not careful, you'll split off the cross-grained visor. Shape the ears as in Fig. 14, and cut away the wood at the temples below the skipper's conservative sideburns. Cut in at the back of his neck as in Fig. 14 and roughen or groove the wood back there to resemble hair. Form the hat strap, side buttons, and cap emblem carefully by shaving away the wood around them—these are distinctive parts of a seaman's cap.

Now draw on lapels and coat collar, lapel buttonholes, collar and tie, as in Fig. 1C. Score deeply along these lines, and shave the wood away outside them so they stand out. Lower the shoulders a little by cutting away outside the collar, and cut them back a little to show the lapels. Now round up the whole figure, shaping up each part carefully according to Figs. 1C and 15. Sleeve creases are just three notches at the inner edge of the sleeve inside the elbow—see Fig. 15. Score the line where the coat laps to button, and round off the coat down to the joint between coat and sleeves. Don't be too careful—a few broad knife cuts will make your skipper distinctive. Now mark the button positions, drill holes, glue in ends of kitchen matches, and cut them off short. If you want the pea-jacket to be strictly "regulation," use six buttons instead of four.

Don't use sandpaper on the skipper; he's a hard-bitten seafarin' man, and sharp angles only accentuate his character. Any paint you have—oils, enamel, lacquer, or even water colors—will do. Make Sam'l's shoes, coat, cap visor, emblem, and strap black, and his trousers and crown of cap white, as in Fig. 1C. His face should be a healthy flesh color with a dash of color at the cheek bones, nose tip, and perhaps chin tip. Hair and eyebrows are white, of course. Pupils of the eyes are black, with a short white line at the left-hand side of each (but don't put both inside or both outside, or the skipper will look cross-eyed). Better give each part two or three coats, and allow plenty of drying time between. Touch up the cap ornament and visor with gold (the ornament should be crossed anchors, if you wish to be exact)—and there's Skipper Sam'l, genial seafarin' man!

FIG. 14

Perhaps you'd like to try some other expressions, other poses, or even other figures. Go to it! You'll find that a touch of your knife or paintbrush will change facial expressions almost miraculously. You can make the old salt smile, grin, frown, laugh, even weep by judicious combinations of line and color. You can give him a close-clipped white beard, stick a pipe between his lips, or provide a cigar. You can change the pattern slightly and have him sitting down, bending over, hobbling with a stick. Or change his cap to a bonnet or shawl, his trousers to a bulging skirt, his pea-jacket to a shawl, and you have a keen-faced old granny. Put on appropriate whiskers, double chins, hats or caps, and jackets, and you can even change his nationality.

You may also want to try an entirely different figure from a pattern you've found yourself. Simply get front and side views of whatever you want to make, transfer them to an appropriately shaped block by the method of comparative squares shown in Fig. 1A, and whittle away. And remember that you don't have to make the skipper the size indicated. Use ⅛-in. squares and halve all my dimensions, and he'll be only 2¾ in. tall—that is, the actual size of Figs. 1A and 1C. Use ½-in. squares and double all my dimensions, and he'll turn out to be 11 in. tall.

So there you are, a sculptor in wood—and I'll bet you thought it would be hard, didn't you?

FIG. 15

Sleeve creases and details of jacket

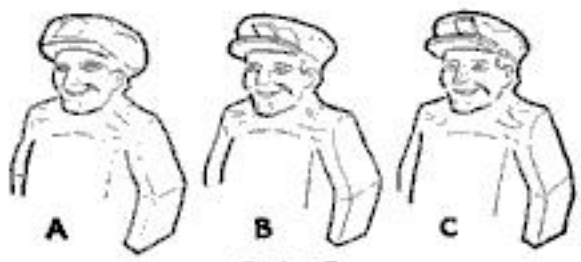


FIG. 13

Here are the cuts required to shape the cap. Be careful not to split or damage the visor

SMALL TOOLS KEPT ON CORRUGATED BOARD

One model maker, who uses many small tools, keeps them on a square of corrugated board so that they cannot roll off and fall to the floor. The board is single faced, and a 1-ft. square of it is glued to a square of plywood, then painted black so that tools and small parts placed on it can be easily distinguished and picked up.—W. K.

AMMONIA CLEANS RULING PEN

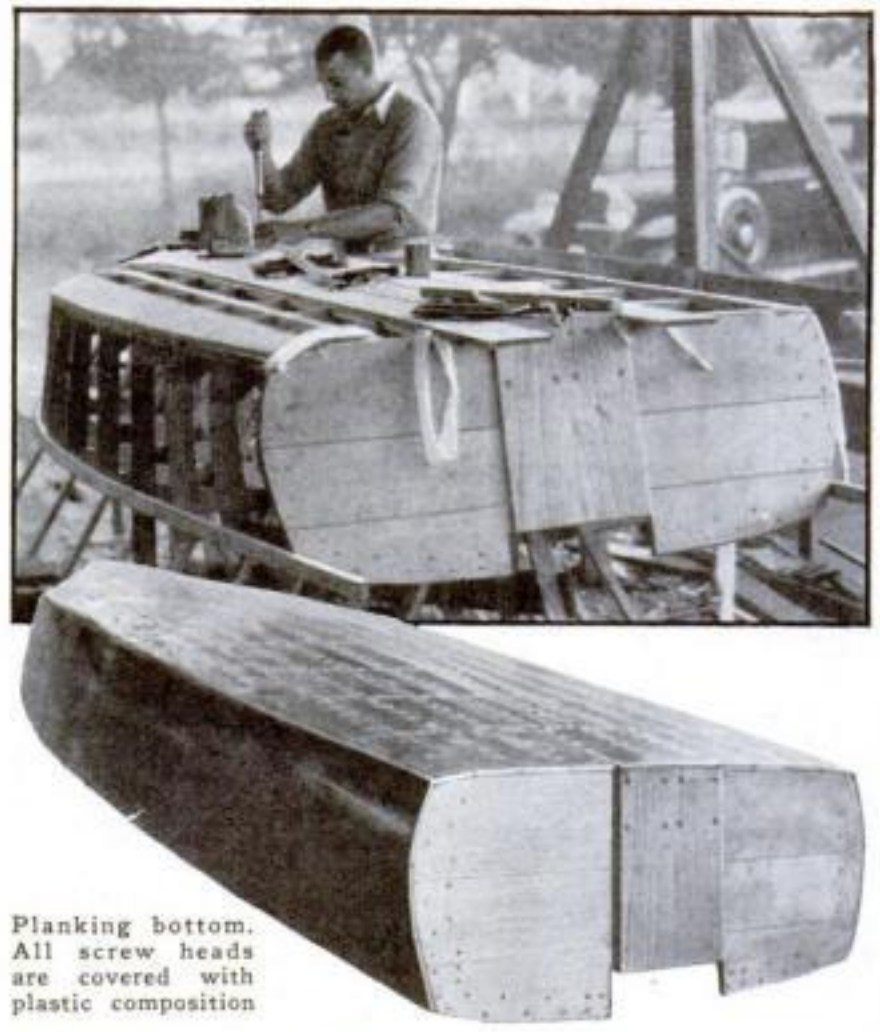
Ruling pens used with India ink can easily be cleaned of incrusted ink by applying a strong ammonia solution with a soft cloth. Afterwards rinse with clear water and dry.

FINISHING OUR NEW RACING RUNABOUT

(Continued from page 67)

from the keel) between stations 2 and 3 and use one plank in their place from that point forward. Butt blocks of the same thickness as battens should be used at these joints.

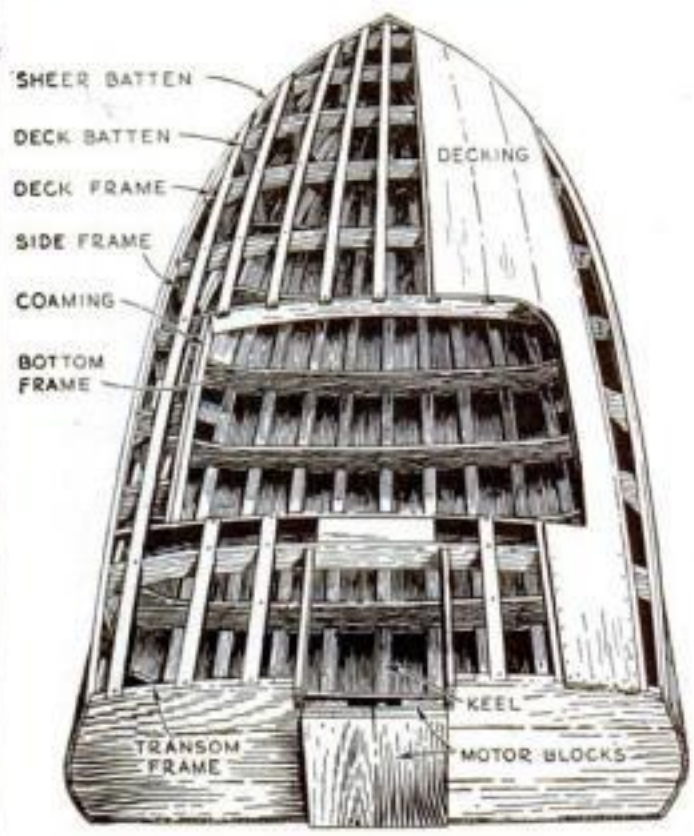
Start by laying the first two planks on either side of the keel. Just before screwing down the planking, coat with marine glue the battens, transom, stem, keel, chines, and all joints that need to be waterproof; then lay a strip of cotton flannelet over the glued surface. Coat the cloth with glue. When the planking is screwed down, the glue will be squeezed over the entire joint, making it completely waterproof. Also, the cloth will hold the glue in place indefinitely. Small battens that cover the bottom transom seam should be made waterproof in this manner. No cloth or marine glue will be needed, of course, in any seams which are above the water line.



Planking bottom. All screw heads are covered with plastic composition

When a plank is being fastened, it should first be clamped in place; then holes are drilled in it for the screws. These screws should be countersunk enough to allow for covering later with putty or seam composition. Screw the side and bottom planking with flathead brass or galvanized screws as follows: (1) A double row into transom and transom frame, 1-in. No. 6, spaced about 1 in. apart; (2) into stem, 1-in. No. 6, spaced not over 1 in. apart; (3) into keel, chines, inner chines, and frames, 1-in. No. 6, spaced about 1½ in. apart; (4) into battens, ⅞-in. No. 6, spaced about 1½ in. apart.

Some planks will have to be steamed, especially the ends of planks near the stem and bottom side planks near the transom. To steam a plank, wrap with rags the part that is to be bent and then soak the rags with boiling water. Once the rags are taken off, the planks must be quickly clamped and screwed into position before they have time to dry.



Before the top side plank is put on, the boat can be removed from the supporting framework and set, right side up, on horses. Fit the breasthook against the stem between the two top battens before the last two side planks are put on. Screw through the battens with 1¼-in. No. 7 screws.

After the side planking is completed, true up the deck beams, bevel the battens and planking along the sheer line, and bevel the top of the transom and transom frame, so that the decking will fit properly. Be careful to get a true curve of the deck fore and aft, especially at the sheer line and center line. The small deck frames Nos. 7 and 8 and also the coaming can be put in at this time.

The deck frame to which the back rest is to be fastened can be set up at any desired angle. It should be fastened at each side to small cleats attached to the two top battens; and at the center it should be connected with a block to deck frame No. 9, as shown in the drawings, with 1¼-in. No. 7 screws. Screw the coaming to this seat-back frame and to deck frame No. 6 with 1¼-in. No. 7 screws, but ⅞-in. No. 6 screws will be large enough for the rest of the construction just described.

Next, the two knees that brace the transom to deck frame No. 9 should be fitted. Fasten them with small angle irons and bolt with 1½-in. No. 10 machine screws. Notches can now be cut for the deck battens. They should be spaced about 5½ in. apart, approximately as shown in the drawings, and fastened to the sheer batten and to the frames with 1¼-in. No. 7 screws. The center batten will be notched part way into the breasthook. Screw the deck to the battens, deck frames, breasthook, transom, transom frame, and sheer batten with ⅞-in. No. 6 screws spaced about 2 in. apart. No marine glue or cotton flannelet is necessary, but the entire inside of the boat should be given a coat of paint at some time before the decking is laid, and all the decking should be painted underneath beforehand.

It will be best to put in, before all the decking is on, proper bracing for the type of steering *(Continued on page 93)*

FINISHING OUR NEW RACING RUNABOUT

(Continued from page 92)

Stern view of the partially completed boat after being turned right side up. Left-over pieces of planking are used for the flooring

wheel to be used. The flooring can be made from extra boards left over from the planking. The seat back is plywood.

The entire hull should be well sanded before the priming coat is put on. All screws should be covered with putty, seam composition, or a plastic wood composition. The entire hull should have at least two coats of marine enamel or spar varnish.

To obtain a natural mahogany finish, first color the hull with either mahogany filler or mahogany stain. Apply either of these with a brush and then wipe off with old rags. Cover screw heads with mahogany colored seam composition. For an extra good racing bottom, use at least three coats of special hard, racing bottom finish; get instructions for applying from the paint manufacturer.

To mark the water line, first set the boat up evenly on a level floor; then mark all the way around the hull 6 in. up from the floor. The sheer molding and fender molding can be either half-round hardwood or ⅜-in. half-oval brass, screwed to the battens with oval-

A bow view. The deck beams should be trued up to give a smooth, fair curve fore and aft

head brass screws. A strip of ⅜- or ¼-in. half-oval brass should also be used to protect the stem. A bow plate or some fitting to which a tow rope can be attached is required by the racing rules.

The best and simplest way to hook up the steering outfit is to use four pulleys, and to run the tiller line or cable to the steering bar through holes bored high in the transom.

In order to get great speed, have the transom as high as the motor being used will allow. Experiment also with motor angles.

BOAT CHANNEL OPENED BY DRAGGING CHAINS

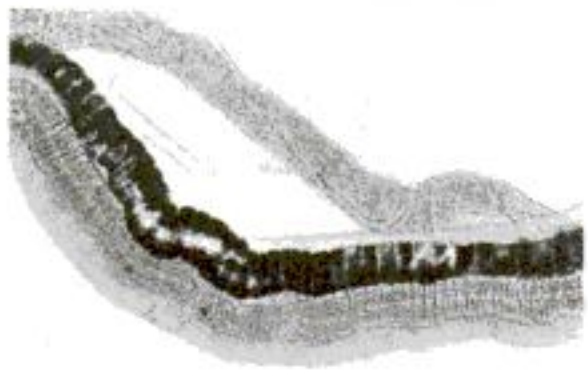
SHALLOW channels that become filled with sediment from the action of the tide can often be kept open by the use of chains. One summer resident of Maine, who had a channel blasted so he could bring his boat into an inlet, always fastens several chains about 30 ft. long to his boat when going in and out. The chains stir up the sediment, and the tide then clears the channel.—O. R. McD.

MARVELS OF THE EARTHWORM SHOWN BY YOUR MICROSCOPE

(Continued from page 41)

pairs, four pairs to each segment. There are two rows along the lower surface of the body, and two along the sides. The setae are chitinous, and if the muscular tissue in which they are embedded is torn apart with dissecting needles, they can be removed. You will find that each little foot or claw is shaped like a letter S that has been pulled out almost straight.

Perhaps the most beautiful part of the earthworm's whole anatomy is the cuticle—the transparent wrapping that covers its body. This cuticle can be stripped off as a very thin, delicate film, particularly after the specimen has soaked for a day or so in the formaldehyde solution. With tweezers, transfer a piece of this membrane to a drop of water on a slide, and lay over it a cover glass. Because of its thinness, you probably will have to adjust the substage diaphragm to a small opening. If your microscope has no diaphragm, put a piece of cardboard or metal



Portion of a nephridium, or excretory organ. There are two of these in nearly every segment

having a small hole in it between the mirror and the stage.

Staining with methylene violet or other standard microscope stain will make the membrane easier to examine. You will find that it looks like a piece of fine silk with polka dots. The dots—frequently they look like black dots—are tiny pores through which secretions pass.

But the most striking feature of the cuticle is its iridescence. When you hold the slide up to a light and turn it, the bit of membrane will be seen to resemble mother-of-pearl or the pearly luster of certain fish scales. It frequently appears highly colored.

If your microscope is equipped for dark-field illumination, you have a treat waiting: you can transform the bit of cuticle into an iridescent fabric that glows with a bluish luster. You can preserve the specimen of membrane indefinitely by substituting glycerin for water as a mounting medium.

The earthworm has two layers of muscle that form the segmented outer wall of its body. Outside, just beneath the epidermis, is a layer made up of fibers which run around the body in innumerable rings. Beneath this is a layer of muscle with fibers running at right angles, that is, lengthwise of the body. With these fibers and muscles the worm can make itself long or short, fat or slender, as may be necessary to its active life.

To see the individual muscle fiber with ease, you must tear a bit of muscular tissue to shreds. You can do this with some degree of success by brute force; but it is more scientific to isolate the fibers chemically. The dissociator, of which there are several kinds, softens or dissolves the material that holds the cells together, yet preserves the cells in their true form. A nitric-acid solution, made by mixing one part of acid with four parts of water, is commonly used for muscle. Let the specimen remain in this solution at room temperature for about three days. Then wash it in water to remove the acid, and separate the fibers with teasing needles. Further dissociation can be accomplished by pressing or tapping on the cover glass after the specimen has been mounted in water. Tissue generally is preserved in a two-percent formaldehyde solution (one part forty-percent formaldehyde to nineteen parts of water) after being removed from the dissociator.

You will find that the earthworm's nervous system lies for the most part along the floor of its body, beneath the intestine. It appears as a white cord having a slight bulge and three pairs of branches at each segment below the fourth. You can remove this cord easily and place it on a slide for observation.

THE earthworm's brain is found in the third segment, counting from the head end and omitting the little buttonlike nose or prostomium. The brain looks like two small, whitish balls, or lobes, lying above the pharynx. From it, two bundles of nerve tissue extend around the pharynx and unite at the bottom; from this "knot" the nervous system continues as the ventral nerve cord.

To dissociate nerve tissue, a formaldehyde solution is used. Add one part of forty-percent formalin to 500 parts of normal salt solution. Let the tissue remain in this liquid for an hour or so. To make a normal salt solution, add one part of common table salt to about 125 parts of water. After the nerve tissue is dissociated, it can be stained with eosin or any other suitable stain.

Every somite or segment of the worm except the first three and the last carries a pair of excretory organs or nephridia, to carry waste matter out of the body. These are coiled tubes leading to the outside through a tiny opening in the body wall. You can see these tubes with the unaided eye, in a large worm. They lie close against the inner surface of the body wall, about halfway up each side; their openings are near the bottom rows of setae. To lift a coiled nephridium out with tweezers and transfer it to a slide for observation is a simple operation.

Permanent slides of bits of tissue may be made with glycerin as a medium. The glycerin keeps the specimen moist, and in a natural condition. It is not good practice to immerse the object suddenly in strong glycerin, however. Instead, transfer it to a fifty-fifty mixture of glycerin and water; then, after a half hour or so, to a drop of pure glycerin placed in the center of the slide. If the object is thick, use a cell of shellac or a ring of glass or celluloid cemented to the slide with balsam or shellac.

WHEN the object is centered properly, breathe on the cover glass to make it moist, and immediately lower it onto the little pool of glycerin; do not include air bubbles. Wipe away, with a damp cloth, any glycerin that oozes out at the edges of the cover glass. Then tack the cover glass in place by applying shellac at the edges. Finally, seal the glass all around with shellac, gold size, or asphalt varnish.

A glycerin mount is not so rugged as one of balsam or some of the other mounting materials, but with reasonable care will last for a long time. To renew the gold size or other sealing material from time to time may be necessary if the slide is handled roughly. It is best to store such slides so that they lie flat rather than stand on edge.

The earthworm can readily be sliced into thin sections on a microtome. It is, of course, necessary to prepare the worm so that it can be sectioned without *(Continued on page 95)*

MARVELS OF THE EARTHWORM SHOWN BY YOUR MICROSCOPE

(Continued from page 94)

being crushed. The usual method is by embedding in paraffin, a process that requires considerable time and skill. Converting two or three segments of an earthworm into slices a few thousandths of a millimeter thick would involve processes something like the following: fixing for an hour or so in a ten-percent formalin solution, followed by washing for thirty minutes in running water, and hardening for at least a day in seventy-percent to eighty-five-percent alcohol; dehydrating by leaving for several hours in ninety-five-percent alcohol, and then overnight in absolute alcohol; clearing by immersion in cedar oil or xylol until the specimen becomes more translucent and sinks to the bottom; immersion in melted paraffin for a few hours, until the paraffin has penetrated the tissues completely; final embedding by dropping the specimen into a paper-box mould containing melted paraffin that has started to harden at the sides and bottom, and then quick immersion in cold water.

THE specimen, surrounded by the paraffin which prevents the delicate tissues from being crushed or displaced, is sliced into thin sections on a hand or mechanical microtome. It would be extremely difficult to do the slicing by hand. A microtome (P. S. M., June '33, p. 32) is almost a necessity, for making thin sections.

Each thin slice of paraffin containing the tissue to be mounted is cemented with egg albumen to a clean slide, the paraffin dissolved away with xylene, the tissue stained with hæmatoxylin, eosin, or other stain, and finally a drop of balsam and a cover glass are added to protect it.

This is, briefly, the widely-used paraffin-embedding method of making sections. Of course, there are variations, according to the specimen, and the worker's pet ideas. It is time-consuming, but gives excellent results. There is, however, a second, quicker method which you may find workable. Fix the piece of earthworm in ten-percent formalin, harden it in alcohol as described, and then transfer it directly to a molten mixture of one part of vaseline and three parts of paraffin. When this has hardened, slice the block into thin sections, cement it to a slide, and dissolve away the paraffin-vaseline mixture with xylene. The final step is to stain it and mount it.

The most interesting sections of the earthworm include cross sections through the body, longitudinal sections through the first dozen or so segments.

Do you remember the sand you found in the worm's intestine? This will damage the edge of the razor or microtome, if left inside the specimen. Therefore, before attempting to slice up the earthworm, put it for two or three days on a diet of wet paper, nothing more. That is, put the worm into a box containing torn and well-wetted newspaper, and let it eat the paper. Eventually the sand and grit of its normal earthy diet will be replaced by the easily-cut paper fibers.

THE earthworm is valuable to you and to everyone else for reasons other than its excellence as a zoölogical specimen. It is one of the most efficient soil-fertilizing agents known. It continually bores through the earth, and swallows soil which later is cast out enriched by nitrogenous waste material, while its burrows allow water and oxygen to enter and aid further the soil-building processes. Over a period of years, the thousands of earthworms in each acre of land will deposit on the surface several inches of enriched soil, covering rocks and other unproductive material. We all owe a lot to the earthworm.

POLO PLAYED ON MOTOR CYCLES

(Continued from page 43)

to the temporary removal of a player from the game, without another being permitted to replace him, or to permanent removal with the substitution of another player.

A goal made in the course of play counts two points. A successful penalty kick scores one point.

The typical motor-cycle club, composed of riders who find as much fun in various motor-cycle activities as the rifleman does in shooting at game or targets, or the stamp collector in studying the peculiar dots on a new air-mail stamp, finds in polo a way of adding spice to week-end programs.

The person who considers a motor cycle only as something for a traffic officer to ride, has little or no conception of the peculiar appeal of this two-wheeled "hobby-horse." Motor cycling is definitely a hobby to thousands of enthusiasts all over the world.

BESIDES polo, the motor cyclist has hill climbs, dirt-track races, short-track races, road races, side-car races, night speedway racing, endurance runs, reliability trials, economy contests, non-stop contests, field meets involving gymnastic riding and various other stunts, grass track racing, "T. T." (Tourist Trophy) racing, and a host of other ways of making life interesting. It sometimes is difficult to say which of these sports provides the most thrills, or involves the most interest. Motor cyclists will cross states and continents to engage in hill-climbing contests or races, and sometimes only to watch them!

"T. T." racing, which duplicates in miniature the famous Tourist Trophy races held each year on the Isle of Man, is proving popular with motor cyclists. Short but difficult courses are laid out in such a way that they involve right and left turns, hills, and similar means of testing the skill of riders. A race usually includes several laps, the winner being the one who makes the trip in the shortest time. It is a hodgepodge of hill climbing, dirt-track racing and several other varieties of motor-cycle sport. Spills generally are frequent, hence the regulation requiring contestants to wear leather crash helmets.

FREQUENTLY, a polo game comes as the climax of a Sunday of activity. It may be preceded by a road tour, a "T. T." race, hill-climbing practice, or other events. And then some of the players wonder why they feel a bit stiff the next day!

Wives and sweethearts frequently are on hand, traveling as back-seat riders. There are surprisingly many women who participate on their own machines, although they usually leave to the men the climbing of perpendicular hills and the juggling of polo motor cycles.

Unlike the polo pony, the motor cycle is a relatively inexpensive mount; playing of the game does not involve costs that would make it prohibitive to all but the wealthy. For that reason, you probably will hear much more about motorized polo in the future than you have in the past.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

DON'T BE A PIECE OF HUMAN DRIFTWOOD

NO SHIP shoves off without destination, yet how many men put out aimlessly on the sea of life with little or no idea where they're going or how they're going to get there! It isn't long before such frail vessels become driftwood—tossed here, swirled there—until the sea casts them upon the sands of time to complete their disintegration.

A few days ago we had a letter from a man in Mexico—a letter of regret. It is not a success story; quite the opposite. But we publish it here because we believe that any man who wants to get ahead will find in our correspondent's drifting the inspiration NOT to do as this man has done.

"Having always been afraid of failure", he writes, "I invariably fail as I dare not try. And if nothing succeeds like success, conversely, nothing fails like failure.

"But if my simple story will help even one poor devil to avoid the mistakes which have left me (at an age I hate to remember) sans achievement, sans money, sans anything, why then I won't feel such a failure after all.

"In the first place, drifting is not only my middle name, but my first and last ones as well. Even yet I haven't decided exactly what I want to do, or to be. I have several preferences and some times dedicate myself to the study of one or the other. But in a few days, before I know it, I've dropped that and find myself taking up something else.

"Strange to say, the vocation that I have never preferred (in fact, the last one I would have chosen) is mine. Somehow, in the most casual manner, I found myself pounding languages into wooden heads for a living. And if I had my choice, it wouldn't be teaching languages or anything else.

"The only compliment that I can give myself is one that I have often received from other people—that I am an excellent teacher. On the strength of that praise, I stick to my desk and the wooden heads, fearing that I might not be excellent, or even passable at anything else.

"Hating change of any form, I am an adherent of the cult of letting well enough alone, even if it isn't so well. Besides, I never do what I intend to, and always do what I have decided not to do. And although I have ambitions a-plenty, somehow that is as far as I ever get. No, I am not lazy; so I cannot blame myself altogether for not doing something or being somebody. Somehow I've never seemed to have had a chance. But I do blame myself for not *making* chances, although this is very hard for one who is not by nature a do-thinger and a go-getter. I just wait for something to turn up, and—nothing ever does.

"Due to my lack of initiative, none of my plans for myself have ever material-

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ized. As one instance of how all of my hopes have been frustrated, I, early in life, decided that I would live some day in one of our northwestern towns whose name spelt enchantment to me. I always loved things northern—pine-covered mountains, snow-covered peaks, gray skies and stormy waters.

"Do I live in that mystic northern land? You would laugh if you knew where I have spent most of my life! Of all the God-forsaken, sandy, cactusy desert regions, my habitat takes the cake. Here the sky is forever blue, and the sun shines 366 days in every leap year.

"If it were possible to change a vacillating nature like mine, I would turn over a new leaf; only, the leaf would not stay turned very long."

Brainy enough to teach languages and to be highly regarded in that profession, this man still thinks himself as a failure. All through life he has drifted—without planning, without objective, without ever making an important decision. Had he started earlier he might have trained his mind into orderly thinking but he believes it's too late now. And more's the pity because apparently his is a good mind.

Thousands of *successful* men today once were in the same spot in which you may find yourself—or in that of our correspondent years ago. They have arrived because they knew where they wanted to go and prepared for the journey. Few of them have had any more time to train their minds and hands than you have. But every spare moment was an opportunity and they seized it.

If you are just starting out in life, decide now *what* you want to do. Then set your course and hold to it.

CHIEF ELECTRICIAN IN LESS THAN A YEAR

EVEN in these times the road to success is not always rough. For some it is a broad, smooth highway without bump or detour, traveled at an almost breathless pace. Take Charlie Peters, for example. When hardly out of high school, Charlie breezed into one of the finest jobs any young man could seek, simply because he made up his mind where he wanted to go and planned accordingly.

Charlie was interested in electricity but—in his own words—he "didn't know a volt from an ampere." Yet less than one year later, at the age of 21, he was making good as chief electrician for a large electric refrigeration factory in Michigan, and supervising men twice his age.

When Charlie left high school and started looking around for a job, he very soon discovered that the average prospective employer is not particularly interested in high school diplomas. The first question asked was: "What can you do?" It started Charlie thinking, and it didn't take him long to reach the conclusion that specialized training was the key to his problem.

Not long after that Charlie, in reading a magazine, discovered the advertisement of an electrical school in Chicago, which offered a practical course of training in

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electricity and refrigeration. Here was exactly what he wanted, and he went after it. Upon graduating, he returned to his home town to land a job with a leading equipment manufacturer. Success was his from the start and after several increases which came with surprising rapidity he was finally promoted to the position of chief electrician.

Starting from scratch, without advanced education or previous experience, Charlie Peters earned promotion to importance and responsibility within six months after he acquired the necessary specialized training, actually out-stripping "old-timers" many years his senior.

Granted that Peters' achievement is unusual, there's no denying the reward which awaits those who will develop their native ability. Employers respect intelligence; couple it with training, and respect will take concrete form—in the pay check.

FOR FIVE YEARS FATE PUSHED HIM AROUND

SOME might say that Winchester Marquart picked a poor time to be born. But having come into the world just in time to run up against the depression upon graduation from high school, this Jersey City, N. J., boy refused to let it stop him. Today—at 25—he occupies a position many an older man might envy.

Marquart didn't get there by any hocus-pocus or because he knew somebody with influence. His sole equipment was good average intelligence, good health and courage. And don't think he didn't get knocked around the first couple of years out of school. He had only begun an industrial chemistry course in New York when the pinch came at home and he had to look for a job.

His first two positions went the way of so many during the economic decline and within a year and a half he was hunting his third. This lasted a year—seven months of it on the night shift—and then it, too, blew up.

By now Marquart was pretty well fed up with insecurity, night work and employment conditions over which he had no control. One thing he had observed, however, gave him hope. *Trained* men in the various places he had worked were kept on; the untrained, let out. He determined to become one of those trained men by studying at home.

Just a little more than a year ago, the United States Government held examinations for storekeeper and gauger of liquors. Marquart was one of the many who took them, and came through with a rating of 86.25% which put him near the top of the eligibility list. Shortly afterward, he was notified of his appointment with a starting salary of $2,000.00 a year and real responsibility.

Now for the first time in five years he is enjoying the security of a good job, backed up by confidence in his ability to hold it. True, Marquart's is a career just begun. But by intelligent preparation he's laid the groundwork for bigger and better things later, and when the next opportunity comes along he'll be ready to grasp it.

AMAZING FEATS OF BLOODHOUNDS

(Continued from page 25)

the bloodhound. And, curiously enough, the bloodhounds in Harriet Beecher Stowe's story weren't real bloodhounds at all. To understand this, we will have to run back for a moment over the history of the animals.

In tapestries 500 years old, you can see the forms of dogs that have a close resemblance to the modern bloodhound. The Romans are said to have used such dogs for hunting the wild boar. Introduced into England, the dogs were found to be too slow for stag hunting. So, according to one legend, breeders crossed them with fox terriers and produced fox hounds.

IT IS doubtful that any real bloodhounds were brought to America until after the Civil War. The dogs used to trail and intimidate slaves in the South were known as "Cuban bloodhounds." These ferocious beasts, part mastiff or great Dane, and sometimes part bulldog, had only a little bloodhound in their make-up. They hunted a man down just as they would an animal and attacked and tore him when they overtook him. Such were the "bloodhounds" of the early South and "Uncle Tom's Cabin." Pure-bred bloodhounds of today will leap up at a treed man, but they are merely trying to sniff him to be sure they have the right person.

After the Civil War, pure-bred bloodhounds were imported to America. Since 1900, it is estimated, $75,000 worth of bloodhounds have come to the United States. Only a few lived, for the animals are relatively delicate and die easily.

Several years ago, I began an experiment in developing bloodhounds with increased vitality. While traveling about the country in connection with the work of the American Eugenics Society, I kept my eyes open for female bloodhounds, seven years old or older. By the laws of heredity, they should produce long-lived puppies. All over the country, I bought up the old dogs and shipped them to my kennels in New Haven, Conn. Most of the thirty-seven bloodhounds I now have came from these long-lived mothers.

Toughey, whose registered name is "Faithful of White Isle," came from this stock. He got his nickname when he was a puppy and swallowed a wire express seal. Sometime later, a curious lump formed on his side. I operated on it and found that the wire and lead had worked through the stomach lining into the flesh of the dog's side. When it was removed, Toughey made a rapid recovery and today, at the age of four years, is one of my best trailers.

The best time of all for trailing is on a cool, damp night. The worst is on a hot, dry day when a strong wind is blowing. Often, on damp winter nights, I find all my hounds restless, pacing back and forth in their pens, sniffing the air. Conditions are perfect; if they are taken out they trail like demons. It is at such times that dogs have made record runs, following trails a hundred hours old or older, in many cases.

ON GOOD scenting days, the dogs may run as much as fifty yards to leeward of the trail, the wind carrying the scent to them. I remember one time taking a pair of young dogs on a training run about dusk. Although I knew the boy who had laid the trail had run along the top of a ridge, the dogs, with noses to the ground, ran along the valley parallel to the ridge top. The cool evening air was descending into the valley, carrying the scent with it. When they came opposite the tree in which the runner had hidden, they turned instantly up the slope toward him.

In training puppies, I usually wait until they are a year old before starting the work. Before that, they are too scatterbrained to get much out of it. Recently, I have been testing out a new system of preliminary training for young dogs.

Several boys line up, and after rubbing liver on their hands, put them behind their backs. All have the liver smell, so the dog can't tell which really holds the meat. Then I give the dog a sniff of clothing belonging to the boy with the meat. If he goes to the right one, he gets the liver; if he doesn't he gets a slap on the nose. This training teaches the pup to associate with something pleasant the job of trailing a scent to the right person. All during the early stages of the training, the dog is rewarded at the end of the trail, and, even later on, the older bloodhounds get rewards occasionally to stimulate their efforts.

THE second step in the training is following a short trail. Neighborhood boys lay the trails for a nickel apiece, and have the time of their lives trying to fool the dogs. There are two half-mile trails on each training trip: one out and one back. Four times a week for about two months, the young dogs get the workout. As they gain in ability, the trails are increased to four or five miles.

The boys carry strips of newspaper, and tear off bits every few yards so I can follow the trail and know if the dogs go astray. During the later stages of the training, if they get off the trail, I flip the strap with which I hold them and the short section of chain attached to the harness slaps them on the back. This is a signal they understand and they instantly circle back.

Occasionally, the dogs get a practice run that isn't on the schedule. Recently, for example, one of the bloodhounds got its foot in a heavy trap set illegally in the woods near New Haven. Taking another dog, I made the rounds of the trap line, taking up the traps and following the trail right to the door of the man who set them.

Because, in their later work, the dogs must meet strange sights and sounds and smells, I make it a practice to carry on the last stages of the training under varying surroundings. They are taken by car to different locations. At the scene where the trail has been laid, I unsnap the holding strap from the dog's collar and snap it to the harness ring. This is the signal to go. Afterwards, I never let go of the strap. If a bloodhound is allowed to run loose, it will soon outdistance you and may get injured.

Most of the later training trails run through game preserves. Puppies will turn off and follow fresh rabbit and fox trails, but the older dogs pay no attention to them. In fact, I have seen rabbits leap out almost under their noses without attracting more than passing interest.

ON a long trail, the dogs have to be stopped by main force, occasionally, to give them rest and water. If left alone, they would work themselves to death. A classic example of a bloodhound that followed a trail to death is Dr. J. B. Fulton's famous dog Jo-Jo.

When a long series of burglaries baffled the police at Pueblo, Colo., Jo-Jo and her mate, XRay, were given the job of tracking down the thief. The trail led out on a high trestle over a river. The dogs and the man handling them were half way across when a train swung around a curve and rushed toward them without slackening speed. Unable to attract the engineer's attention, the man leaped thirty-five feet *(Continued on page 101)*

AMAZING FEATS OF BLOODHOUNDS

(Continued from page 100)

into the river below, dragging one dog with him. But he was unable to budge Jo-Jo. She continued on the trail until she was run down and killed.

These same dogs, during one of the early years of the present century, followed the longest trail on record. At Oneida, Kans., a burglar made his get-away with a horse and buggy. A currycomb used on the stolen animal gave the dogs the scent, and they set out after the horse. With short pauses for food, rest, and drink, they followed the trail from Wednesday morning until Friday night. At Elwood, Kans., 135 miles from Oneida, the bloodhounds got their man.

IN CONTRAST, take the shortest trail ever run—ten feet. It saved the lives of three children. An insane woman in Kentucky had tied her children up in a chicken coop while she sharpened an ax to kill them. They were found in time and the bloodhounds of Captain Mullikin sniffed the ropes with which the children had been tied and walked ten feet to the woman. She confessed what she had planned to do and was confined to an institution before she could harm the children.

At the end of the training period, before I sell one of my dogs, I give it a severe test to make sure it can hold the trail. Early in the morning, a boy lays a five-mile trail that ends in a zigzag run across a New Haven golf course. Twelve hours afterwards, when players have been tramping over the greens and fairways all day, the dogs have to follow the trail to the end. Once, on an evening after 1,000 people had been on the course watching a tournament, a dog accomplished the feat without apparent difficulty.

Every once in a while, a chase ends in a comic climax. I recall one instance of the kind which occurred several years ago. A lost person was thought to have gone through a gate near a brook. We put the dogs on the trail. They ran to one pool, zigzagged about, and headed upstream to the next pool; there they repeated the performance. For a mile and a half, we worked upstream, circling at every pool. We had come to the conclusion the lost person must be fishing, when the dogs sighted their quarry, two photographers making scenic pictures along the brook!

When I give a bloodhound a piece of clothing or an object to smell, I take pains to be sure that only the person wanted has worn or handled it recently. Once, when I was just beginning with the dogs, I let them sniff a doll belonging to a lost child. Without any preliminary circling, they started off down the road at top speed. At a neighbor's house, they ran to a sister of the lost baby. She had been the last to play with the doll.

THE professional fee for trailing with bloodhounds is fifty dollars for taking the dogs out, and seventy-five dollars if the hunt requires more than one day. I have never heard of a single trail being followed for more than two days. Probably the largest check ever cashed for bloodhound work was given to Captain Mullikin by a coal company in the South; it was for $5,000 and represented three months' work in running down a gang of wreckers. On another occasion, the Cuban Government hired Mullikin for six months to trail assassins.

According to statistics, there are only 167 owners of registered bloodhounds in the country. The total number of pure-bred animals available does not exceed 400—the total of trained dogs, under 100—far too few when their value is realized. An important advance in the future is likely to be a wider application of the amazing ability of bloodhounds for finding people who are lost.

U. S. PATENT NO. 2,000,000

(Continued from page 13)

placing the engine in a casing simulating a horse. This "horse" was mounted upon wheels which were driven by the engine, and to preserve the old order, the vehicle was controlled by numerous reins.

In its broader aspect, the Patent Office is the greatest scientific and mechanical library in the world. Like any library, the Patent Office offers its records to the inspection of the public, but is unique in that it maintains in print copies of the entire 2,000,000 United States patents, which are offered for sale at ten cents each. It also supplies photographic copies of foreign patents, publications and the like, at nominal cost. The yearly demand for copies of United States patents amounts to 7,000,000; while approximately 978,000 photostats of foreign patents and publications are furnished. In this respect, the Patent Office is the greatest "dime store" in the world.

WHILE the Patent Office is the world's greatest scientific and mechanical library, the public too frequently loses sight of the fact. A short while ago—and it is an everyday occurrence—an applicant appealed to the courts from the refusal of the Patent Office to grant him a patent on his alleged invention. At the trial this applicant stated that he had expended two years in inventing the device of his application. The court replied: "We think that the patents to which we have been referred by the examiner, if consulted by the applicant, would have taught him how to overcome his difficulties." This inventor had not employed the Patent Office for its greatest purpose, that is, as a library where one may obtain all the information pertaining to any scientific subject.

Nor do manufacturers far excel the general public in making proper use of the library. A few have patent departments, but the majority just drift along until they get into a patent "jam," whereupon patent lawyers are employed to extricate them. Once, while going through a large acid plant operated by one of our leading fertilizer companies, I asked my guide whether their chemists used the Patent Office to keep posted on new developments and improvements in sulphuric-acid manufacture. He replied, "There hasn't been an improvement in sulphuric-acid manufacture since Gay-Lussac." A short time afterwards a superintendent of this same plant came to me about certain new and valuable discoveries he thought he had made in sulphuric-acid manufacture. To his amazement we found his idea had been patented more than fifty years before.

IN THE cases just recited, the parties had overlooked the fundamental purpose of the Patent Office, as a library for the use of industry. Let me repeat, the real object in establishing the Patent Office was, in the words of the Constitution itself, "promotion of science and the useful arts" for the benefit of all mankind. Primarily, it contemplated the establishment of a huge storehouse for accumulated scientific and technical information. This purpose is too often lost sight of by reason of the incidental reward offered the inventor in the form of a patent. Obviously the drafters of our Constitution would never have troubled themselves for the simple purpose of aiding sporadic inventors.

Each new idea is the seed of hundreds, sometimes thousands, of subsequent patents covering improvements, refinements, and variations. The ordinary person can recite at least 100 improvements that have been introduced in the automobile in the last ten years. There are far more inventions, however, made in machines, processes, and alloys used in the manufacture of automobiles than there are patents covering the automobile itself. One oil company holds more than 1,200 patents and applications covering developments in an oil-cracking process! It is due to such step-by-step developments that second-rate gasoline of today compares favorably with the high-test motor fuel of a few years ago. Similarly, the first crude concept of a cash register has furnished the basis of several thousand patents.

In the development of the linotype, one man, the late John R. Rogers, patented more than 500 improvements. Rogers was induced by his brother to become a printer. "This is a good, safe job, the brother said. No machine can take it away from you." The inventions of Rogers never took away jobs. He actually made more and better jobs, though he changed the nature of the work. In developing another field, Carlton Ellis has been granted 601 patents, mostly on chemical compositions, lacquers, paints, and paint removers.

ELIHU THOMSON, one of the founders of the General Electric Company and a revered contemporary of Edison, has devoted his life to the development of electricity. Up to date, he has been granted more than 700 patents, each marking one step, along the road to mechanical perfection.

When one reads that Thomson has been granted over 700 patents, Edison over 1,100, Ernst F. W. Alexanderson of General Electric 252, and John Hays Hammond, Jr., 289, the conclusion is immediately drawn that professional inventors are the chief contributors to the Patent Office. Nothing is farther from the truth. The people named are the exceptions. The great majority of our patents were taken out by sporadic inventors. Cartwright, a clergyman and poet, invented the power loom. Eli Whitney, a New England school teacher, conceived idea of the cotton gin while sojourning in Georgia; Arkwright, a barber, invented the spinning frame; H. G. Wells, the writer, suggested the military tank, and the automatic telephone exchange was the inspiration of an undertaker. The Wright brothers, inventors of the airplane, were bicycle mechanics.

The Segal lock is a case in point. Segal was a New York City policeman. In the course of his duty he encountered numerous instances where apartments were entered by prying between the door jamb and the door. Segal then conceived building the lock with a catch to prevent such entrance. Segal drifted into the lock business, formed the company which bears his name, and, in a relatively short time, sold his business for a price in the millions.

Few inventors can produce both quality and quantity in inventions. In the final analysis, the ability of an invention to fill a want is paramount. Some of the greatest inventors made relatively few inventions. The Wright brothers took out only five patents. Samuel F. B. Morse, and Eli Whitney, both appear to have made only one invention, the electric telegraph and the cotton gin respectively.

THE truth is, we are all more or less inventors, albeit some of us are very humble ones. To say of a man that he is a good engineer, or a good plumber, is but to praise his inventive ability. Every time the carpenter varies the rule-of-thumb in his daily work, each time the housewife improvises something to facilitate her tasks, an invention is made, not always of a high order, perhaps, but nevertheless an invention. The first crude sharpened spear of prehistoric man drew upon the inventive faculty. The bow and arrow was one of the great inventions of antiquity, while the discovery of the use of the wheel was a still greater one.

Today, one *(Continued on page 103)*

TWO MILLIONTH PATENT

(Continued from page 102)

cannot scan the yearly index of patentees without finding the name of some acquaintance, some neighbor perhaps, or even a relative, so cosmopolitan is the roster. As one's eye runs down the list, names appear which never before were associated with inventions. Dr. Einstein patents a refrigerator; Josef Hoffman, the great pianist, takes out several patents on automobile steering mechanism; Cornelius Vanderbilt, Jr. patents a shoe-polishing cloth; and the street sweeper patented by Col. John Jacob Astor is juxtaposed with that of a poor unknown. The name of our great President Abraham Lincoln is democratically mingled with the names of some unsung inventors.

MORE than 15,000 of these patents have been issued to women. For instance, Miss M. E. Knight invented the modern paper bag. Mrs. Martha J. Coston invented the flare light used for signaling by mariners all over the world. Miss Beulah Louise Henry, sometimes called the Lady Edison, has forty-two inventions to her credit.

To indicate the universality of the inventive urge, let us consider in brief detail some one field—say athletics. Walter Hagen is known the world over as a golfer. Few people, however, are aware that he has patented a golf ball having a surface design which, he states in his patent papers, makes the ball "accurate in flight as well as in putting and rolling."

Rene Lacoste, the French tennis player, learned much on the tennis court and his most valued experience he has passed along in the form of patented inventions in racket structure.

Sandow, the "strong man," in order to demonstrate his strength with exactitude, devised various strength-measuring apparatus and patented them.

In baseball, player-inventors are almost as common as player-managers. If you have ever seen Max Carey, formerly of the Pittsburgh Pirates, slide into a base, you may have wondered what saved his hide. Well, Max always used a special sliding pad which he himself invented and patented. This pad, his patent states, "will protect the parts of the body likely to come in contact with the earth while sliding to a base, whether the slide be feet first or head first."

On the other hand, Benjamin Shibe, owner of the Philadelphia Athletics, has patented a mass of inventions on player equipment, including baseballs and baseball-making machinery. It is under his patents and in his own plant that he manufactures the balls used by the American League.

CHARLES BRICKLEY, former Harvard football star and All-American fullback, is said to have been the greatest drop-kicker of all time. Sports writers attributed his success in goal kicking to his "educated" toe. They probably did not know that Brickley wore a patented shoe of his own invention, which deserved at least some credit for his spectacular performance.

The prize ring offers the same story. Bob Fitzsimmons had trouble during training in keeping the punching bag properly placed. As a result he designed and patented a punching-bag support which obviated the objections he had experienced.

These are only a few of the curious facts revealed by a study of the two million patents on record at the Patent Office. Far more significant is their testimony to the inventive genius of Americans and of the foreign-born citizens who have found encouragement and opportunity here. What will the next million patents provide for the increased comfort and safety of the race?

ENTERTAIN YOUR FRIENDS WITH CHEMICAL TRICKS

(Continued from page 45)

property. Divide some of the liquid between two test tubes, adding a drop of hydrochloric acid to one and a drop of sodium hydroxide solution (lye water) to the other. Now stand the test tubes where they will not be disturbed; convenient supports are large, flat corks bored with holes in which the tubes may be inserted. After about twenty-four hours, the clay particles in the acidified tube will settle out, leaving a clear liquid, while the clay in the tube containing alkali will not settle out for days or even weeks. The particles in the sodium-hydroxide solution are believed to become electrically charged so that they repel each other and hence do not tend to gather at the bottom of the tube. This experiment will often work with other kinds of clays, and the experimenter may find it interesting to try those found in his locality.

ANOTHER chemical trick that not only is amusing but demonstrates a property of water glass (sodium silicate) is the manufacture of "chemical ice."

Pour some water-glass solution into an ordinary tumbler and add to it some muriatic acid. In the reaction that follows, a stiff, white, sandy precipitate will be formed that will adhere to the glass and have all the characteristics of a chunk of partly-frozen ice. Because it is difficult to remove the "ice," once it has formed, it is best to use an old jelly glass for the experiment. If this test is performed in a test tube, it will be necessary to throw the tube away when the experiment is completed.

The white substance formed is silicic acid. If heated in an open flame, it will be transformed into pure silica or white sand.

Incidentally, a bottle of sodium silicate provides a handy cement for use around the home laboratory. In its concentrated form, known as water-glass sirup, it can be used for cementing glass, cardboard, and many other substances. As a matter of fact, it often is used commercially as an adhesive in the manufacture of corrugated boxes and large cartons.

By using two simple chemicals, you can make a novel solution that is so heavy that it will float stones and other heavy objects. To prepare this high-gravity liquid, make a strong solution of potassium iodide and saturate it by dissolving in it a large amount of red mercuric iodide. The resulting solution will be more than twice as heavy as water. A vial of the liquid, with small stones floating on its surface, forms an interesting curiosity for your laboratory shelf. Be sure, however, to use a strong solution of potassium iodide and plenty of mercuric iodide. Also, since the solution tends to attack metals, it is best not to attempt to float rings or other objects made of valuable metals on the liquid.

NEW CHEMICAL METHOD FOR AIR CONDITIONING

A NEW way to take the humidity out of the air in a home or building, recently reported to the American Chemical Society, is to draw the air through a spray of lithium-chloride solution. The chemical absorbs the excess moisture, and may be re-concentrated by boiling whenever it becomes too diluted. Because only a small amount of electrical power is required, the new air-conditioning method is declared cheaper than removing the humidity as dew by chilling the air. If it is necessary to cool the air as well as to dry it, this process is made much easier when the air is predried. The efficiency of an air-conditioning system using refrigeration is increased two and a half times by predrying the air by the chemical method.

HERE'S THE ANSWER

(Continued from page 48)

distance. Fishermen will tell you they have often seen stubborn fish back away from the bait.

It Gives Them the Willies

H. E. A., PORTLAND, ORE. In Australia, any violent wind storm such as a cyclone or a hurricane is called, in common speech, a "willy-willy." This expression is said to have been taken from the language of the Negro Bushmen.

The Teeth of a Lion

Q.—WHERE does the dandelion get its name? —L. J., Binghamton, N. Y.

A.—THE name of the dandelion is said to come from the peculiar shape of its leaves. The French called the plant "dents de lion" or "teeth of the lion."

Well Dished Out

B. D., PHILADELPHIA, PA. The expression "apple-pie" order was once "cap-a-pie order" and meant "armed from head to foot."

Under-Moon and Under-Sun

R. D. R., SAN FRANCISCO, CALIF. Pear-shaped images of sun and moon, hanging from a ring around either heavenly body, are recognized phenomena seen most often by aviators flying over mist and clouds at sunrise or sunset.

Can't Fool the Boll Weevil

R. N. C., TORONTO, ONT. Extermination of the boll weevil is made more difficult by a peculiarity it has. Most weevils will fly into a lamp at night, but the boll weevil is not attracted by a light, although it flies in the dark. Therefore it cannot be snared in lighted nets.

The Long, Long Trail

B. C. S., PITTSBURGH, PA. The longest known Indian trail was the warpath of the Six Nations. It extended from northern New England to Georgia, and was a primitive communications system most effective in its day.

Pick a Soft Place

Q.—WHAT kind of terrain should be sought for a landing field for gliders?—P. J. M., Bernardsville, N. J.

A.—A FIELD completely surrounded by hills.

Why the Dime?

H. E., DALLAS, TEX. A ten-cent piece is called a dime because in the thirteenth and fourteenth centuries, in England, the Latin word *decimus,* from *decem,* ten, was used to describe the tenth part of one's income, in tithes. An early form of the word was *dyme.* The word is appropriate today because the dime is the tenth of a dollar.

The Forbidden Hue

C. C., BATON ROUGE, LA. Motion picture studios have a rule against the wearing of dead white by performers, because white causes halation in photography. Pale yellow is generally used instead.

As the Crow Does Not *Fly*

S. G., CULVER CITY, CALIF. The expression "as the crow flies" is a result of careless observation. The crow zigzags considerably in flight.

SCIENTIFIC SHOOTING GALLERY REVEALS SECRETS OF GUNPOWDER

(Continued from page 21)

is fitted, very snugly, a hardened steel piston, at the base of which is placed a small copper cup or gas check to act as a gas-sealing device. The upper end of the piston presses against a little cylinder of carefully prepared and calibrated copper or lead of standard length, which, in turn, is backed by a metal block attached rigidly to the barrel. The pressure generated by the powder gases, ruptures the cartridge case directly below the end of the piston, causes it to move upward against the copper or lead crusher cylinder and, acting like a small hydraulic press, compresses it into the shape of a tiny barrel, and, of course, reduces its length. It is a simple matter then to insert the compressed cylinder between the jaws of a specially calibrated micrometer and read off the pressure directly on the dial. The bullet, in the meantime, travels out of the barrel in the usual manner, with a very slight decrease in velocity due to a small loss in gas pressure from its action on the piston.

THIS is the method used in routine tests. When research problems are being pursued with utmost exactness, a more delicate and accurate method is used. Quartz crystals replace the lead or copper crusher cylinder. It is a well-known property of a properly cut quartz crystal that, when suddenly compressed, it generates electricity. In the pressure test, the quartz piezo-electric crystals are connected to a cathode-ray oscillograph so timed that a record is obtained of the electric current generated when the piston, forced outward a mere few thousandths of an inch by the expanding powder gases, causes the crystals to be compressed. From this record, not only the pressure in pounds per square inch can be determined, but also the rate at which it was developed.

Velocities of bullets are measured by a delicate electrical device, called a chronograph, which operates on the principle that the acceleration due to gravity on a free-falling body is a constant and well-known value. A bullet, immediately after leaving the muzzle, breaks a fine copper wire carrying an electric current. When it strikes the armor-plate target, it causes a metal ball, resting in a V-shaped groove, to jump into the air, breaking the circuit between the two insulated sides of the groove.

Back in another room of the laboratory, the breaking of the wire causes a magnet to release an iron rod sheathed in copper and coated with lampblack. When the bullet strikes the target and the metal ball jumps into the air, a second rod is released. As it falls, it strikes a trigger that releases a knife-like arm which makes a mark on the first falling bar. By measuring the distance between this mark and a previous calibration mark and making a calculation using the acceleration of gravity and the known distance over which the bullet traveled, the exact velocity of the bullet can be determined. This, of course, is the average velocity between the cross wire and target, and not the absolute velocity at any given point. The velocity at the muzzle, or at any other point, can be calculated with reasonable accuracy from this value. For extremely accurate measurements of velocity under research-laboratory conditions, equipment employing photo-electric cells instead of mechanical circuit-breaking devices is used.

MODERN smokeless powder, made with guncotton as a base, is used in a great variety of shapes. Some foreign countries use a form of powder that looks like strips of thin wood. Practically all powder used in the United States is either in the form of flakes, small grains, or cylinders carrying one or more perforations, the type used depending on the service it is required to perform. Guncotton, which the chemists call nitrocellulose, and other ingredients are mixed with ether and alcohol or similar solvents, and pressed through dies to form tubes or rods which are cut into desired lengths. Through the length of the grains extend tiny holes, from one to seven, depending on the grain size. The size and spacing of the holes are important, for they determine how rapidly and effectively the powder will burn. Smaller grains have a tendency to accumulate charges of static electricity, which might cause accidental ignition. Therefore, the grains are given a thin coating of fine graphite, which short-circuits each grain, and prevents the accumulation of a charge.

NITROCELLULOSE in its pure state is unfit for use in firearms. It has to be toned down by certain materials known as deterrents. These absorb heat rapidly, and so slow down the rate of burning and consequent generation of gases. Incidentally, these deterrents also reduce the tendency of the powder to absorb moisture.

Smokeless powder actually undergoes a water-steeping treatment at a late stage in its manufacture, after which it is dried and made ready for use. Likewise, at army depots, smokeless powder not needed immediately often is stored in concrete tanks flooded with water. When it is to be used, it is removed and dried, the latter process requiring a week or so. Similarly, powder is kept, in some parts of the world, beneath mountain-lake waters, where low temperature and moisture combine to prevent accidental ignition.

An incident that occurred during the World War serves to demonstrate further the waterproof qualities of nitrocellulose powder. A ship carrying a cargo of this explosive for one of the allied nations was sunk in the Black Sea. The enemy, knowing the location of the sunken vessel, later salvaged its cargo and used the powder with perfect success.

The performance of a modern rifle or pistol cartridge is more than a matter of powder composition. The density of loading, size of powder grains, type of primer, size and shape of bullet, manner of crimping (folding the edge of the cartridge case inward to confine the charge), and the material of which the cartridge case is made, all are important and must be balanced one against the other for best results.

WHEN it was first decided to manufacture high-speed ammunition for .22-caliber rifles, a larger quantity of higher-powered powder was loaded into the regular copper shells. It soon became apparent that stronger cartridge cases would be required; therefore, brass had to be used. Frequently, high-velocity ammunition is loaded with a double-base powder; that is, one which contains both nitrocellulose and nitroglycerine.

If there is a lesson to be learned by the gun fan in the work being done in the modern powder laboratory, it is that smokeless powder, which means most of the powder used today, is not the simple thing that he had imagined it to be; behind its dependability is a vast amount of scientific research, study, and constant testing. He would learn that the use of non-corrosive primers, which do not deposit metal-eating potassium chloride in the barrel of his gun, will save him hours of labor and, with occasional cleaning, will keep his gun in good condition.

BUILD THIS PORTABLE PUBLIC-ADDRESS SYSTEM

(Continued from page 55)

When not in use, the microphone can be stored in convenient clips mounted inside the cover

of maintaining its inductance rigidly at 150 milliamperes current. The dynamic speaker field (1,200 ohms) serves as the second choke.

The power-bleeder resistor should have a resistance of 7,500 ohms, although a 10,000-ohm unit can be used without causing difficulty. In any case, its rating should not be less than fifty watts, and preferably seventy-five watts. Cathode resistors for the two type '76 tubes should be of the two-watt variety and the 250-ohm resistor in the negative high voltage lead should be rated at twenty-five watts. This last resistor also should be provided with a tap at 130 ohms.

Care must be used in wiring the 12-mfd., 150-volt electrolytic condensers into the circuit. The positive lead of the condenser, in each case, should be connected to the ground.

As to the voltages, the three type '42 tubes (triode-connected) should have a positive plate potential of 380 volts, measured at the tube socket and the current should be approximately twenty-five milliamperes to each tube with no signal. The two type '76's should have a positive plate potential of 200 volts measured at the tube socket with a plate current of approximately five milliamperes. The rectifier plate voltage ahead of the filter network should be 420 volts. A transformer delivering 350 volts will be large enough, provided that an extremely low-resistance B-filter choke is used to allow at least 300 volts at the plates of the '42 tubes.

The parts required are as follows:

Condensers

Three 8-mfd., 500-volt, electrolytic
One 12-mfd., 150-volt, electrolytic
Two 12-mfd., 25-volt, electrolytic
Three .5-mfd., 600-volt, electrolytic
Two .25-mfd., 400-volt, paper
Two .01-mfd., tubular

Resistors

Three 60,000-ohm, 1-watt, carbon
Two 50,000-ohm, 1-watt, carbon
Two 150,000-ohm, 1-watt, carbon
Two 100,000-ohm, 1-watt, carbon
Two 3,000-ohm, 2-watts, carbon.
One 250-ohm, 25-watt, wire-wound
One 7,500-ohm, 75-watt, wire-wound
One 250,000-ohm, volume control

Transformers

One 500-ohm line input tapped at 200
One class "A Prime" push-pull input
One push-pull output for triode '42's
One power transformer, 840-volts, center-tapped at 420 volts, 150-MA rating
One B-filter choke, 10 henries at 200 MA

Miscellaneous

Tubes, sockets, wire, switch, knobs, speaker, line cord, chassis, leather-covered case, nuts, bolts, etc.

TRICKS THAT ADD TO DRIVING COMFORT

(Continued from page 56)

personally," Gus agreed. "But it does show what I'm driving at. The point is that some change in the regular arrangement may help. Take the cushion that supports your back. Sometimes, building out the padding near the bottom, or perhaps half way up, or even at the top, will make the cushion a better fit for your particular type of anatomy. At any rate it certainly is worth trying. You don't have to tear the cushion all apart to find out, either. You can hang a thin, wafer-edged pad by strings from the coat rail at different heights just to try out the idea."

"SOUNDS reasonable. I'll make some tests when I have the time," said O'Hara, interestedly. "Still, I don't think it will do much good. No matter how comfortable the driving position is, I'm always dog-tired at the end of a long run, and that's pretty often. You know how much I'm on the road."

"All the more reason why you should try out all the possibilities," Gus advised. "But, as you say, a driver can get tired even though the seat cushions and the position are perfect."

"I'll say he can," O'Hara grumbled.

"You and a lot of other drivers get tired on long trips because you don't know how to rest yourself while you're driving. I've watched you, and you always sit in exactly the same position with your hands resting on wheel in exactly the same places, and your feet always just so. Why don't you work out some changes and then keep switching every so often before you've stayed long enough in one position to get all cramped? I don't care how comfortable your first position may be—you ought to change now and then. Staying in one position without any movement, even for half an hour, is harder work and more tiring than ditch digging."

"I don't see how you can get much of a change in driving a car," O'Hara protested. "You've got to have your hands on the wheel and your feet near the pedals, haven't you?"

"You do unless you want to give the insurance adjusters a workout," laughed Gus. "But you can make at least a couple of dozen shifts without risking your neck.

"Look," Gus directed, sitting down in one of the office chairs. "You can sit up straight like this, or you can slump down for a while to move your spine and keep it from 'freezing.' Slumped down in the driver's seat is no way to drive for long, but it's fine for a short change because it puts so many joints in a new position. Then, you can hold the wheel with both hands up near the top of the rim. That pulls out your arms and changes the strain on a lot of muscles that may be getting tired from holding the rim quite close to you, as you usually do.

"AND, there's two variations that help to throw strains first to one side and then to the other side of your body. I mean with one hand up and the other down—like this. You'll see lots of second-hand cars with the wheel worn only in two places. The birds who owned 'em never got wise to shifting their hand positions.

"Of course, you can't move your left foot very far and still keep it handy to the clutch pedal, but it will relieve the stiffness to pull it in close to you every little while to ease your knee joint and your hip joint on that side as well. Don't forget that you can do the same thing with your right foot if the car is fitted with a throttle control on the steering column. You shouldn't try hand control of the throttle when you are in traffic, but it works well when you're out on a long stretch of straight road."

NEW STUDIES OF BONES SHOW HOW WE GROW

(Continued from page 15)

baby was two, her father had deserted his family. The resulting turmoil in the broken-up home had left its indelible mark upon the bones of the child.

From an examination of a skeleton, or an X-ray picture of a living person, Dr. Todd and his coworkers can decipher many of the main events in the health-history of the individual. Knowing how the body develops, they can name the time when injuries occurred.

THEIR tests have shown that some parts of the body grow faster than other parts and at different periods. Before adolescence, for example, almost four sevenths of a child's growth is in its legs. This explains why so many boys and girls are spindle-legged. The head, on the other hand, is one fifth adult size at birth, two thirds adult size at the age of one year, and four fifths adult size when the child is six. The vestibule of the ear, which controls body balance, is full-sized at birth.

After adolescence, the legs grow more slowly but the growth of the trunk speeds up. When anything upsets bone development in either the period before adolescence or the period after, a below-normal stature results. Achondroplastic dwarfs, with trunks almost normal length but with legs only half as long as they should be, show the effect of interference with bone development before adolescence. At the opposite extreme are those with underdeveloped trunks and long legs. Their arrested development came after adolescence.

Another significant thing noted at the Brush Foundation laboratory is the fact that the eye, which to the anatomist is part of the brain, reaches full growth at the age of from four to six. This is why children often look big-eyed. It also explains why persons whose facial growth has been interrupted have large, staring eyes.

The fact that there are periods of maximum growth for each organ and area of the body offers a new technique for the analysis of disease and for determining the physical history of a patient. As part of the investigation work at Cleveland, Dr. Todd gives a series of lectures to the fathers and mothers of the children who coöperate in the experiments. The X-ray negatives in the file also guide the mothers in regulating the child's diet.

Almost as soon as the child is born, its first measurements go into the record. The depth and breadth of its head, the length of its legs, and a score of other measurements give a picture of its physical start in life. This is supplemented by negatives made with the X ray.

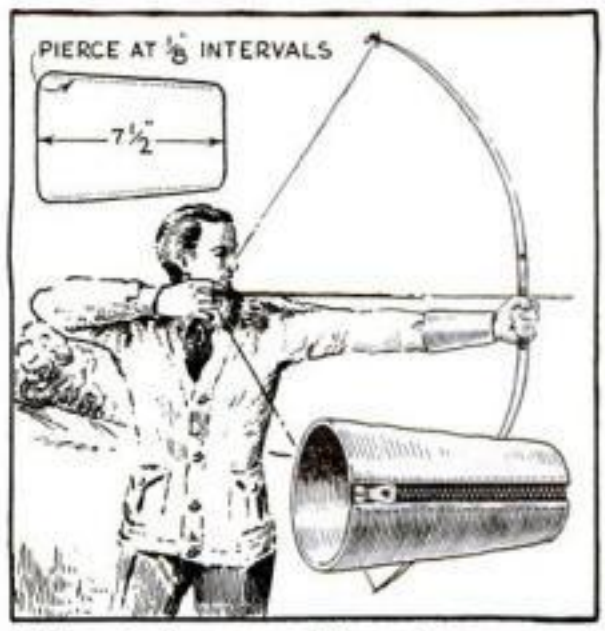
FROM then on, the child is measured and radiographed at frequent intervals. Every variation in size, every change in rate of growth, is noted by the experimenters. Thus, over a period of years, they build up a complete fact-and-photograph record of the child's development.

In addition to having his internal anatomy photographed and his outside dimensions taken periodically, the child is persuaded to "draw a picture of the man" by demonstrating traits in various psychological tests. He assembles hose clamps and bicycle bells to discover his mechanical ability; hangs numbered coat checks on hooks to show his muscular control; pokes needles into holes in a disk to demonstrate his steadiness of nerve.

Out of this accumulating mass of records, the scientists at Cleveland hope to evolve information aiding millions of children to a heritage of better health.

Thus, the arc lamp of Charles Francis Brush, after illuminating thousands of city streets for five decades, is playing a part in throwing light upon something vastly more important, man himself.

NEW FASTENER IMPROVES ARCHER'S ARM GUARD



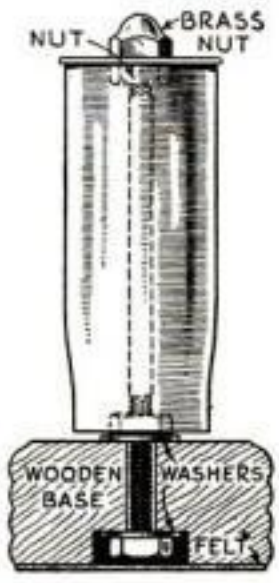
This archer's arm guard is easier to put on than the ordinary type with laces or buckles

LACING the conventional type of archer's arm guard, or bracer, is always a difficult job. This trouble may be overcome by using a fastening of the familiar and easily obtainable sliding type.

Obtain a suitable piece of heavy leather and lay out as shown so that one end is a snug fit just above the wrist joint and the other a fit for the muscles of the forearm. Allowance should be made for whatever clothing is to be worn while shooting. Cut the piece carefully and soak until soft. Pierce the slanting edges every ⅛ in. with an awl and to each sew one part of the fastener, arranging it to work from wrist toward the elbow when closing. Put the bracer on while wet and leave until it has dried to shape; then wax and polish.—JACK HAZZARD.

DINNER GONG MADE FROM OLD WAR SOUVENIR

MANY World War veterans have empty shells from the battle front stored away in some box or corner as souvenirs. One of these shells, if polished and mounted on a wooden base like the one illustrated, will make an attractive dinner gong. In spite of its smallness, this gong gives a mellow tone that is loud enough for the average house.



The size of the base and the supporting bolt will depend, of course, on the size of the shell to be used. Select a good piece of hardwood for the base and turn it to any desired shape. After varnishing or otherwise finishing the wood, glue a piece of felt on the bottom. — J.P.K.

Strange Pranks of the Air Currents

(Continued from page 39)

When static electricity, caused by sand storms, interfered with automobile ignition systems, resourceful motorists "grounded" their cars

ered the surface of water in rain barrels and pools. The mysterious, glowing dust was highly inflammable and, according to imaginative spectators, burned with an odor like sulphur. We now know that instead of being brimstone and a manifestation of the devil, the particles were simply the pollen grains of a certain variety of pine tree.

Spores and seeds, as well as pollen grains, ride the breezes and thus play a vital part in spreading plant life over the surface of the earth. Hay, grain, and other farm products have been carried aloft and dropped at distant points. And, diatoms, rotifers, and the eggs of small creatures are known to make long journeys borne by the wind.

None of these heavier-than-air objects, of course, "float." They are continually falling. The only reason they stay aloft is that they are caught by currents of air moving upward faster than the objects are dropping. Like gliders, they soar through the sky supported by rising columns of air.

At Lawrence, Kans., Providence, R. I., and other places, fish have fallen from the clouds. The simple explanation offered by science is that the fish are carried aloft by waterspouts and are transported overland by the swirling currents of the upper air.

Not long after the Civil War, a rain of reptiles frightened early dwellers in Minnesota. Careful descriptions of the living creatures which dropped from the clouds have enabled zoölogists to determine that they were the larvae of newts. Where they came from is still a mystery.

FROG rains are also on record, one having occurred at Windham, Conn., in the last years of the nineteenth century. The small animals pelted down in the midst of a rainstorm. A short time afterwards, a shower of tadpoles took place in New York City, handfuls of the black, wriggling creatures falling on Fourth Avenue. Small toads have also been carried aloft and dropped during storms.

How far and how fast air currents flow through the sky, bearing their strange freight, has been demonstrated dramatically on a number of occasions.

In 1918, for instance, a great forest fire swept through the woods of upper Minnesota. Dense smoke rolled eastward and in a southerly direction. The smoke and cinders passed Duluth, Minn., in the evening and arrived over Indianapolis, Ind., the next morning. By evening it was over Washington, D. C., and Western New England. By the next day, it had reached Georgia and the following morning was reported from Texas.

Even wider was the spread of the cinders sent aloft by the great Chicago fire in 1871. Charred particles fell in the Azores Islands forty days after the conflagration. And, in the early Nineteenth Century, when volcanoes in the Sunda Islands, near Sumatra, exploded like great bombshells and hurled thirty-six cubic miles of rock, dirt, and dust into the sky, the particles circled the globe several times. They resulted in lurid sunsets and made 1816 famous as "the year without a summer." The curtain of floating dust cut off so much of the solar radiation that people in New England wore overcoats in mid-July.

The quietest air in America is said to be over Roseburg, Ore. For an entire year, Weather Bureau instruments there showed the average speed of the wind to be only three miles an hour. Chicago, "the Windy City," had a yearly average of fifteen miles an hour, and New York even more—seventeen. At the opposite extreme from Roseburg is Point Reynes, Calif., a small peninsula jutting out into the Pacific north of the Golden Gate, where the winds have the highest average of any recorded by the U. S. Weather Bureau.

Atop Mount Washington, N. H., last winter, lonely scientists recorded a 231-mile-an-hour gale, the fastest moving air ever timed with accuracy. Electrically heated anemometers, functioning perfectly in the bitter cold, made the feat possible. Fifty years before, observers in a low stone house, chained to the rocks, had recorded a 186-mile-an-hour wind near the same spot.

Of course, in hurricanes and tornadoes the wind attains the highest speeds of all. No one has ever timed the rate at which the air spins in the deadly funnel of a tornado. Calculations place its speed at 500 miles an hour.

IN THE grip of such winds, the most fantastic of all the air riders take to the sky. Church steeples, timbers, sheep, men, houses, are all sucked aloft by the spinning cones.

At Beauregard, Miss., some years ago, a piece of iron weighing 675 pounds sailed through the air for four blocks and in South Carolina a 600-pound timber, forty feet long, traveled a quarter of a mile. In Southern Illinois, a twister picked up a house roof and carried it like a piece of paper for fourteen miles. Farther on, it wrenched off a high church steeple, sucked it aloft and transported it, sailing through the sky, to a spot almost twenty miles away.

In Missouri, a bridge that weighed 216 tons, was lifted from its foundation and hurled into the river, a tangled mass of wreckage. At another point, the same twister followed the course of a stream for several hundred yards, sucking all the water into the sky and leaving the bare bed of the stream exposed.

What is probably a world's record for tornado activity was set in February, 1884. Between 10 a.m. and midnight on a single day, sixty tornadoes left a trail of destruction across central and southern states. For fourteen hours, the wind ran amuck. At the end of that time, 800 people had been killed, 2,500 had been injured and 10,000 buildings had been destroyed.

THE most destructive single twister in history ripped its way across Missouri, Illinois, and Indiana in March, 1925. It killed 695 people, injured 2,027, and destroyed property worth $16,500,000. Usually, the path of a tornado extends for no more than twenty-five miles and the average width of its destructive swath is about 440 yards. Often the tip of its spinning cone jumps and skips along the ground bringing destruction where it touches and leaving unscathed what it passes over.

In Missouri, not long ago, a tornado circled a barn, tearing up great trees on all sides of it but leaving the building unharmed. On another occasion, a twister lifted a house into the air, carried it over a row of high trees and dropped it on the other side, leaving the trees standing stripped of leaves and bark.

The whirling air acts as a great suction pump, and clouds of dust and debris are carried in the cone. Sometimes, tornado clouds are shaped like an hour glass, the small ends of two cones meeting in midair. Usually, however, they have the form of a single funnel. It may be either light colored, inky black, or livid green. Often its approach can be heard for miles, the sound resembling the roar of a train crossing a steel bridge.

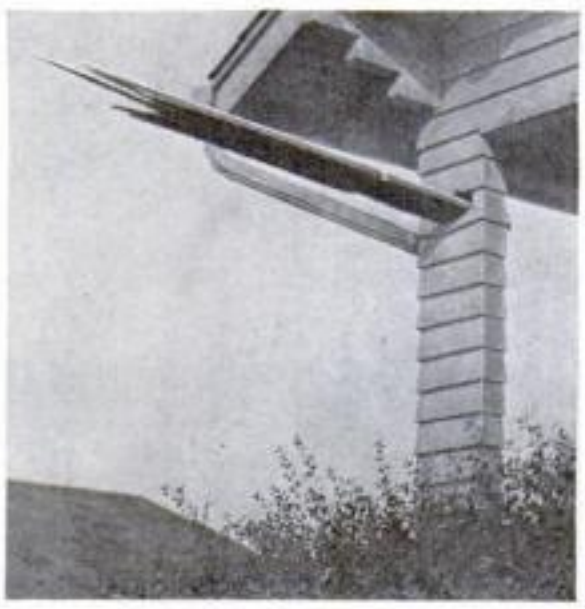
Almost always, these terrors come in the afternoon between three and five o'clock. Although the wind in the cone is gyrating at fantastic speeds, the funnel itself moves forward at a rate of between twenty-five and fifty miles an hour. An express train or an automobile, traveling in the same direction, could keep ahead of it.

Throughout the United States, the average number of tornadoes is about 100 a year. The old idea that twisters never strike twice in the same place is upset by statistics. In fact, one unlucky village in Western Kansas was hit by a tornado on the same day of the same month, at almost exactly the same hour, for three years in succession!

WHEN objects ride aloft in the grip of tornado winds, the unbelievable becomes the commonplace. Chickens have sailed through the air for more than a mile and landed stripped of all their feathers. Sheep have been shorn of their wool. Lumber wagons have been left with the spokes torn out of the wheels. Potted geraniums have been carried through the sky for three-quarters of a mile and left on the ground uninjured. And, in one southern state, a basket, containing fifty pounds of books, rode a cyclone for two miles and was found hanging on the limb of a tree with all the books intact!

Even more weird was a sight reported by reliable witnesses in a western state. During a tornado there, a horse and buggy were lifted bodily into the air and sent sailing through the sky 100 feet from the ground!

Thus, the passengers of the wind run the gamut from horses and buggies at one extreme to pollen grains drifting on lazy summer breezes at the other. In between, are a host of curious, unexpected, surprising voyagers that ride the columns of invisible air above the surface of the earth.



Hurled like a lance by a tornado, this heavy beam stuck in the clapboard pillar of a house

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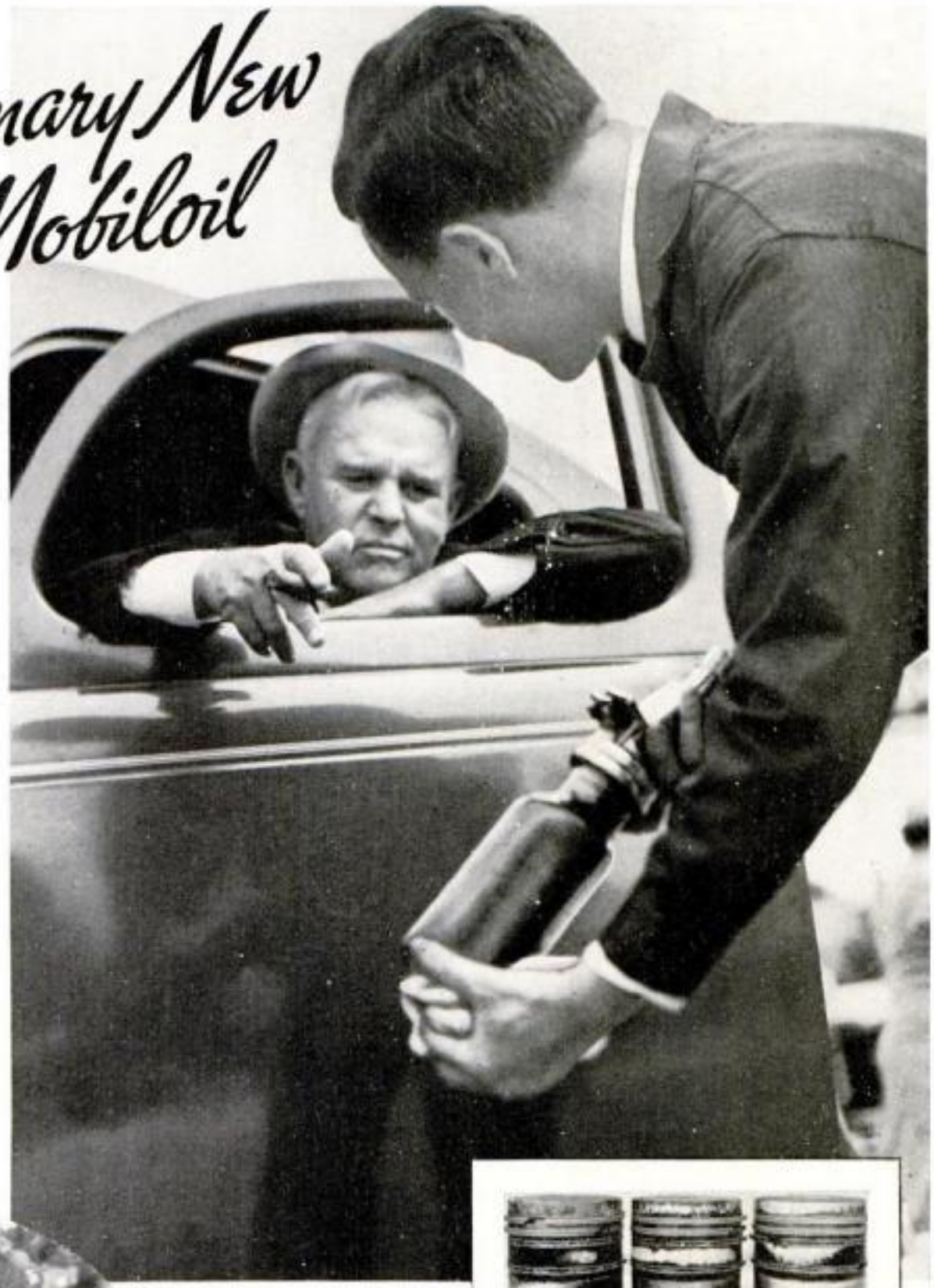

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